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Pesticide risk profile for the feeding of vegetable waste to cattle and sheep

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Abbreviations

ai	active ingredient
APVMA	Australian Pesticide and Veterinary Medicines Authority
bw	body weight
DM	dry matter
ECRP	Existing Chemical Review Program
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
g	gram
GAP	good agricultural practice
ha	hectare
HAFT	Highest average field trial
JMPR	Joint Meeting on Pesticide Residues
kg	kilogram
LOD	Limit of detection for the analytical method, sometimes also used for limit of determination which is the same as LOQ
LOQ	limit of analytical quantitation
mby	meat by products
mg	milligram = 0.001 grams
MRL	maximum residue limit
mby	meat by products
N	Negligible residue (when next to US MRL)
PAFC	primary animal feed commodity
PHI	pre-harvest interval
P_{ow}	octanol water partition coefficient
ppm	parts per million = mg/kg
PSD	Pesticide Safety Directorate
TF	transfer factor = concentration in animal tissue or milk divided by concentration in feed
TRR	total radioactive residue
US EPA	United States of America Environmental Protection Agency
WHP	withholding period
*	before MRL indicates that the residue is at or about the LOQ, <i>i.e.</i> should be less than the LOQ

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Potential for violative residues in cattle and sheep fed vegetable wastes

In times of drought, as sources of animal feeds become scarce, the feeding of crop waste is increased. A relatively abundant potential source of animal feed is vegetable waste. The following details the potential risk that the feeding of such waste to animals poses to Australian trade in red meat.

Commercialisation and concentration within localized areas of vegetable production and the high degree of management involved in milk production and in finishing animals for slaughter has generally restricted the use of vegetable by-products as feeds for dairy and beef cattle. Under normal circumstances, their limited nutritional value in relation to potentially excessive transportation and/or processing costs precludes their use in many feeding operations (as a guess 10-20% of vegetable production may be available for use as animal feed).

Australian Vegetable Production 1999 (Leo Cirillo, The Australian Horticultural Statistics Handbook, 2000/2001 edition, Horticulture Australia Limited)

Commodity	Volume (tonnes)
Potatoes (total)	1,326,765
Tomatoes (total)	394,371
Carrots	256,608
Onions (white & brown)	233,989
Lettuce	131,140
Rockmelon & cantaloupe	101,045
Pumpkins	87,589
Cauliflowers	73,432
Watermelon	66,364
Peas, green (total)	65,726
Sweet corn	57,172
Cabbages	53,171
Celery	43,208
Capsicum (including chillies and peppers)	41,262
Broccoli	39,389
Mushrooms	37,568
French & Runner beans (total)	30,380
Beetroot	29,682
Cucumbers	17,920
Chinese cabbage (Bokchoi & wombak)	16,033
Zucchini	14,153
Sweet potatoes	13,299
Parsnips	10,170
Asparagus	8,878
Melons (excluding rockmelon & watermelon)	7,398
Marrows & squashes	5,729
Onions (spring including shallots)	5,146
Leeks	4,436
Swedes	3,897
Silverbeet & spinach	3,492
Peas, snow	2,029
Witloof Chicory	1,452
Radish	1,264
Turnips (white)	1,184
Garlic	147

Currently there appears to be only limited use of vegetables or vegetable by-products as feeds for either dairy or beef cattle in Australia. Reduced animal performance may occur when such products are fed. Whole cull carrots are reported to be very palatable and 20 to 40 kg of fresh material are readily consumed/cow daily. Overseas, cull vegetable or processing wastes including carrots, cauliflower, Brussels sprouts, artichokes and broccoli are used as feeds and there is some feeding of winter vegetable residues to beef cattle.

Chemical residues in animal feeds may be transferred to the tissues of livestock on feeding. While it is unlikely that the chemical residues present in meat and offal arising from feeding represent a concern regarding food safety they can result in disruption to trade where the relevant Australian and overseas market standards differ.

The observation of chemical product withholding periods does not guarantee that the chemical residues in the feed are such that when fed to livestock, the residues in meat and offal will meet export market requirements.

The aim of the current report is to profile the risk of violative residues in meat and edible offal posed by the presence of pesticide residues in vegetables and their waste fed to cattle and sheep.

Assessment of currently registered chemicals that may be used on vegetable crops

Estimates of residues in livestock tissues and milk are usually made on the basis of the propensity of a chemical to transfer to tissues and milk combined with anticipated animal dietary exposure.

Most experiments in the area of transfer of pesticide residues to animal tissues and milk following ingestion have been designed based on the requirements of regulators. The relevant studies required are livestock metabolism studies (lactating goat or dairy cow) and animal transfer (feeding) studies.

The feeding studies are used to determine transfer factors (TF) that are defined as the ratio of the pesticide residue in the tissue or commodity of interest (fat, muscle, liver, kidney or milk) to the residue in the diet (expressed on a dry matter intake basis).

In utilizing transfer factors derived from feeding or metabolism studies for risk assessment management purposes, the user needs to be aware of the limitations and assumptions used. The TF derived is dependent on the duration of the feeding or dosing, the concentration in the feed or dose level, the nature of the feed (if added to the feed), lactational status, bodyweight, age, sex and breed of the animal studied. For chemicals administered as a mixture, the presence of other chemicals may alter the metabolism and/or rate of excretion by induction of the various routes of decontamination. The duration of a feeding study required for the steady state concentration to be reached in tissue or milk is a function of the elimination half-life. Residue definitions set by different regulators are not always the same and residue definition is a factor that should also be taken into account when utilizing TF for managing residue risks and trade. Care must be taken in extrapolating TFs from goat metabolism studies to all ruminants as is demonstrated by endosulfan, for which the residue definition is the sum of α -endosulfan, β -endosulfan and endosulfan sulphate, where only low levels of residues are found in goats but significant transfer to tissues occurs for cattle^{1,2}.

¹ Indraningsih, McSweeney, C.S. & Ladds, P.W. (1993) Residues of endosulfan in the tissues of lactating goats. *Aust. Vet. J.*, **70**, 59-62.

The transfer factors utilised here were calculated from residues reported in the scientific literature using the highest individual animal tissue divided by the nominal feed level. If the highest residue was not reported the average residue divided by the nominal feed level were used instead. In the case of milk the average residue was divided by the nominal feed level.

For the purposes of profiling risk conservative estimates of animal dietary burden (intake) are required. The APVMA “*Stockfeed Guideline Document 1 Primary Feed Commodities As A Proportion of Livestock Diets*” (Version 1.1 March 2002)³ lists the maximum proportion of vegetable derived feeds (vegetables not specifically grown for grazing or fodder, vegetable by-products such as potato peel, cannery waste and by-products and vegetable oils and fats) included in animal feed as 5% however, 100% was used in the current evaluation unless stated otherwise. Estimates of residues in vegetable derived feeds were obtained from scaling of literature studies, MRLs or based on conservative assumptions. The dietary burden is then the residue in crop × maximum proportion in the diet. To overcome errors that may result from differences in moisture contents of feed items it is accepted practice to calculate dietary burdens for a ration on a dry matter basis. For the purpose of the current evaluation if residue data were not available on a dry matter basis, no attempt has been made to correct for dry matter content.

The estimated residue in animal commodities is:

$Residue = TF \times dietary\ burden$ [ppm DM basis]

Unless stated otherwise, the following assumptions have been used in the risk assessment:

- The crop has been treated at the maximum rate and with the shortest interval between application and harvest/grazing permitted by the product label⁴.
- The vegetables are harvested at maturity and that the culls/processing waste are derived from these vegetables.
- The maximum rate of incorporation in the ration/diet is 100% except for tomato pomace for which 30% has been used.
- That residue transfer for cattle is greater than for sheep and therefore that the assessment of residues in cattle also covers sheep.

The potential for violative residues in animals is assessed against the Australian, Codex and US tolerances as listed in December 2005⁵ (alternative criteria could be selected). Other markets may have different standards, however, for the bulk of Australian meat exports it is assumed that if the lower of these tolerances (or the LOQ of the analytical method if no Codex or US tolerance exists) can be met, the feeding of vegetables/waste will not pose an unacceptable risk.

Appendix 1 provides the details of a risk assessment for each of the compounds registered in Australia for use on vegetables.

² Reregistration Eligibility Decision for Endosulfan Case No. 0014 EPA 738-R-02-013 November 2002 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

³ http://www.apvma.gov.au/residues/Stockfeed_Guideline_1.pdf

⁴ In general, only one or two product labels were selected per pesticide. There is a possibility that the maximum permitted rate may be higher than identified.

⁵ MRLs and approved use patterns change with time. The assessments include the most recent decisions of the Codex Alimentarius Commission (28th Session, July 2005) with regard to Codex MRLs, US tolerances as listed in the Code of Federal Regulations at December 2005 and MRLs as they appear in Table 1 of the APVMA *MRL Standard* as at December 2005.

Most of the compounds registered for use on vegetables also have registrations in other crops that are major animal feed commodities. Indeed, for most compounds listed in appendix 1 the major route of exposure for animals to the chemical is expected to be through feeding of these other crops (pasture, cereal waste etc).

The conclusion of the analysis is the risk of residue violations in meat and edible offal posed by the feeding of vegetables and their wastes derived from crops treated with currently registered products is low for the majority of chemicals. Based on the available information, the following pesticides are identified as requiring further investigation and/or the development of additional risk management strategies:

Pesticide	Crop	Tissue	Residue (mg/kg)		Decline information	
			Estimated ¹	Target ²	Crop	Animal
Bitertanol	Beans forage/fodder	Liver	0.27	0.01	Yes	No
Carbaryl	Sweet corn fodder	Kidney	0.5	0.2	Yes	No
Chlorothalonil	Vegetables	Kidney	5.2 (sweet corn)	0.5	Yes	Yes
Chlorothalonil (HCB) ³	Vegetables	Fat	0.11	0.01	No	No
Chlorthal-dimethyl (HCB) ³	Vegetables	Fat	0.13	0.01	No	No
Dicofol	Vegetables	Fat	1.5	0.01	Yes	No
Emamectin	Brassicas	Liver	0.006	0.001	No	No
Flubendiamide	Brassica vegetables, tomatoes, capsicum	Fat	0.2	0.01	Yes	No
Imazalil	Potatoes	Liver	0.51	0.01	Yes	No
Linuron	Carrot tops, potato	Offal	0.28	0.01	No	No
Maleic hydrazide	Potato	Kidney	3.9	0.01	No	No
Prochloraz	Lettuce	Liver	0.56	0.01	Yes	No
Quizalofop-ethyl	Green bean forage/fodder	Kidney	0.1	0.01	No	Yes
Tau-fluvalinate	Cauliflower, tomato	Fat	0.025	0.01	No	No
Tetradifon	Tomatoes, cucumbers, beans, celery, peppers	Fat	2.8	0.01	No	No

¹residue in tissue estimated using assumptions outlined above

²target residue = lowest of Australian, Codex and US MRL or in absence of these the LOQ (often assumed to be 0.01 mg/kg)

³hexachlorobenzene (HCB) is an impurity present in chlorothalonil and chlorthal-dimethyl at up to 100 mg/kg. The figures reported relate to this impurity and residues arising from it accumulation in the environment

NOTE: the labels for imazalil and prochloraz contain statements advising against the feeding of treated produce and/or by-products. They are included in the above table as it was felt that in some situations, especially processing waste, it is unlikely that information regarding the residue status of the product is transmitted by fruit and vegetable processors, central markets, packing sheds or juice factories to livestock producers.

Adequate data were not located to enable an assessment to be made for the following compounds: bupirimate, dichlofluanid, difenoconazole, fluroxypyr, metaldehyde, oxycarboxin, parathion-methyl, phenmedipham, procymidone, prothiofos, pyrazophos, terbutryn and tridemorph.

The current assessment has only identified pesticides of concern and not considered industry based QA programs that address the potential for residues in animal feeds to transfer to animals and mitigate risks; The National Vendor Declaration (NVD) form for traded livestock and the Commodity Vendor Declaration (CVD) and By-product Vendor Declaration (BVD) forms which are used for traded livestock feedstuffs.

Assessment of persistent organochlorine pesticides in vegetable crops

It should be noted that Australian agriculture has in the past used persistent organochlorine compounds (OCs) and if grown on a site with historical uses that the wastes may be contaminated

with organochlorine residues in the soil. The last use of persistent organochlorines was in the early 1990s. OCs were used in Australia prior to 1981-1985 when they were deregistered.

Persistent organochlorine compounds are the most commonly monitored analytes in surveillance programs. The table below shows some internationally accepted MRLs for the persistent OCs that have in the past been registered in Australia.

International MRLs for beef fat

Compound	MRL (mg/kg)						
	Australia	Codex	Canada	EU	Japan	Korea	USA
BHC	0.3	-	-	0.3	-	2	0.3
DDT	5	5		1			5
Dieldrin/aldrin	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Heptachlor	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lindane	2	2	2	2	-	-	7

Note in the past Japan and Korea have utilised Codex MRLs when they have not set tolerances of their own

In Australia, the following stock food MRLs apply. They have been set at levels that will ensure that the Australian (and international) MRLs for meat (fat) will be met.

Standards for stock food in NSW and Queensland

Compound	Primary animal feed commodity MRL (mg/kg)		
	NSW ¹	Qld ²	MRL Standard
BHC	0.02	0.02	0.02
DDT	0.05	0.05	0.05
Dieldrin/aldrin	0.01	0.01	0.01
Heptachlor	0.02	0.02	0.02
Lindane	0.1	0.1	0.1

¹ Stock Foods Act 1940; Stock Foods Regulation 1997

² Agricultural Standards Regulation 1997 (adopts stock food tolerances from Table 4 of the MRL Standard)

Provided that the vegetable waste meets the Australian primary animal feed commodity standard for the different OCs, there should not be any concerns over violative residues.

Appendix 1

2,2-DPA (2,2-dichloropropionic acid also known as dalapon)

- is a systemic herbicide used for the control of annual and perennial grasses and rushes. It is registered on a variety of crops including potential animal feeds sunflower, maize, soybean and pastures. The application rates are 1.5-3.7 kg ai/ha for the crops mentioned above and up to 3.7 kg ai/ha for *potatoes*. Application to potatoes is by spray applied between rows. No harvest WHP is required.

All crops have the following grazing restraint:

DO NOT graze or cut for stock food for 6 weeks after application

There are no Codex or USA MRLs for 2,2-DPA in animal tissues. The critical Australian MRL is 0.2 mg/kg for meat (mammalian) and *0.1 mg/kg for milks. Residues are not expected in potatoes at harvest (MRL for vegetables *0.1 mg/kg). Therefore no residues are expected to result from the feeding of potato culls or processing wastes to animals. Dalapon and all of its known breakdown products dissolve easily in water. They are readily washed from cells and tissues. Because dalapon is insoluble in organic solvents and lipids, it does not build up in animal tissues^{6,7}.

It is anticipated that animal product residues will be below typical method LOQs.

2,4-D

- is a selective herbicide used widely for the control of emerged broadleaf weeds prior to sowing crops. It is registered on a variety of crops including potential animal feeds pasture and cereals at rates up to 2.2 kg ai/ha. Use on *sweet corn* is up to 0.675 kg ai/ha when the crop is 10-30 cm high and before tasselling. It is also used as a preparatory spray for fallow or seedbeds prior to sowing. Use on *potatoes* is as a pre-harvest aid with application at rates up to 1.6 kg ai/ha made 4-5 weeks prior to harvest.

No harvest WHP is required.

There are Australian, Codex and USA MRLs for 2,4-D in animal tissues however, the residue definitions that apply differ. The residue definition for Codex and Australia is parent compound. For the USA the residue definition is the sum of 2,4-D and 2,4-DCP. This added complication potentially makes comparison of the respective MRLs more difficult. The Australian MRLs are 0.2 mg/kg for meat (mammalian), 2 mg/kg for edible offal (mammalian) and *0.05 mg/kg for milks. The critical USA tolerance is 4 mg/kg for cattle kidney while the MRL for milk is 0.05 mg/kg. The critical Codex tolerances are 5 mg/kg for edible offal, 0.2 mg/kg for meat (mammalian) while the MRL for milk is 0.01 mg/kg. The Australian use-pattern is such that residues are not expected in sweet corn trash at harvest. Therefore no residues are expected to result from the feeding of sweet corn trash or seed to animals. The MRL for potatoes is 0.1 mg/kg.

The 1998 JMPR reported maximum residues in maize forage of 5.2 ppm at 7 days after application at 0.58 kg ai/ha. In an animal transfer study cows were dosed at the equivalent of 1446, 2890, 5779 and 8585 ppm in the diet for 28 days⁸. Residues in liver, kidney, muscle and fat for the 1446 ppm

⁶ Kuhnert M, Freytag B, Freytag HH, Fuchs V. (1992) [The tolerance and residue accumulation of sodium-2,2-dichloropropionate (Dalapon) administered over 90 days to dairy cows] *Dtsch Tierarztl Wochenschr.* 99 (4), 148-51. German.

⁷ Fertig, S. N.; Schreiber, M. M. (1961). Effects Of Herbicide Ingestion. Effect of dalapon ingestion on performance of dairy cattle and levels of residue in the milk. *J. Ag. Food Chem.* 9:369

⁸ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

group were 0.2, 6.5, 0.24 and 0.51 mg/kg respectively. Assuming sweet corn forage has residues at the same level as the maize trial (5.2 ppm) and using TFs from the 1446 ppm feeding study, anticipated residues in kidney and fat from feeding at 100% of the diet are $5.2 \times 0.0045 = 0.02$ mg/kg and $5.2 \times 0.00035 = 0.002$ mg/kg respectively. The LOQ for tissues was reported to be 0.05 mg/kg. Residues in tissues of animals dosed at the highest feed level declined with a half-life of <1.5 days.

It is anticipated that animal product residues will be below typical method LOQs.

Abamectin

- is a macrocyclic lactone insecticide used for the control of various insects and mites. It is registered on *tomatoes* for the control of pest mites and Tobacco leaf roller. The application rate is up to 10.8 g ai/ha.

The harvest WHP is 3 days.

Tomatoes have the following grazing restraint:

DO NOT feed treated produce to livestock for 3 days after application

There are Australian, Codex and USA MRLs for abamectin (avermectin in the USA) in animal tissues. The MRLs for cattle fat are 0.1 mg/kg in Australia and 0.03 mg/kg in the USA. The Australian cattle milk MRL is 0.02 mg/kg while the US MRL is 0.005 mg/kg. The Codex MRLs are 0.1 mg/kg for cattle fat, 0.05 mg/kg for cattle kidney, *0.01 mg/kg for cattle meat and 0.005 mg/kg for cattle milk. The Australian use-pattern is such that residues are expected in tomatoes and in tomatoes haulm at harvest. The Australian MRL for tomatoes is 0.05 mg/kg and for forage and fodder of sweet corn 0.02 mg/kg. . The USA MRL for vegetables, fruiting is *0.0 mg/kg.

A transfer factor of 0.02 for liver when fed at 0.1 ppm in the diet was reported⁹. Applying this TF to the maximum residue in tomatoes fed at 30% of the diet gives a liver residue of 0.0003 mg/kg ($0.3 \times 0.05 \times 0.02$), less than the relevant Australian, EU and USA MRLs. If tomato residues are expressed on a dry weight basis they might be 5× higher. Abamectin is widely registered internationally as an animal protection product with associated MRLs and is not considered to present a significant risk to Australian trade.

The TF for milk is 0.04 giving an anticipated milk residue of 0.0006 mg/kg ($0.3 \times 0.05 \times 0.04$).

It is anticipated that animal product residues will be below typical method LOQs.

Acephate

- is an organophosphate insecticide used to control insect pests in a variety of vegetables.

Application rates are up to 0.97 kg ai/ha for *brassic*as (*Brussels sprouts, cabbages, cauliflower and broccoli*) and *tomatoes*, 1.125 kg ai/ha for *lettuce* and 0.485 kg ai/ha for *potatoes*.

The harvest WHPs are 3 days for the vegetables listed except broccoli which has a harvest WHP of 14 days.

Acephate residues decline with typical half-lives of 30 and 5 days for soil and foliage respectively.

There are Australian, Codex and US MRLs for acephate in animal commodities, however the residue definitions differ. The Australian residue definition is parent compound though the metabolite methamidophos also has its own set of MRLs. The Australian MRLs are 0.2 mg/kg for edible offal and meat mammalian [except sheep meat] and *0.01 mg/kg for sheep meat. The Codex and US residue definitions are the sum of acephate and methamidophos. The US MRLs have all

⁹ Pesticide Residues in Food – 1992 evaluations. Part II. Toxicology. WHO, WHO/PCS/93.34, Geneva, 1993

been set at 0.1 mg/kg including milk. The Codex MRLs are 0.05 mg/kg for meat and 0.02 mg/kg for milk.

The Australian MRLs for Brassicas, tomatoes, lettuce and potatoes are 5, 5, 10 and 0.5 mg/kg respectively. The JMPR has reported PFs for tomato cannery waste and pomace (dry) of 2 and 1 respectively. In animal transfer studies with lactating cattle the transfer factors for muscle, kidney and milk were 0.008, 0.017 and 0.015 respectively¹⁰. It is considered unlikely that residues of acephate in animal tissues would exceed international tolerances.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Acetamiprid

-is a neonicotinyl insecticide used for aphid control. On *potatoes* it is used for control of green peach aphid at a maximum application rate of 45 g ai/ha.

The harvest WHP is 7 days.

DO NOT graze or cut for stock food.

There are Australian MRLs for acetamiprid in animal commodities at *0.01 mg/kg except for edible offal for which the MRLs are *0.05 mg/kg. The potato MRL is *0.05 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Acifluorfen

-is a herbicide that is used to control Prince of Wales feather in *green beans*. The application rate is up to 0.168 kg ai/ha with a maximum of 3 applications per growing season.

The harvest WHP is 28 days

There are Australian but no Codex or US MRLs for animal commodities. The Australian and US residue definitions differ, parent for Australia and sum of acifluorfen and its metabolites (the corresponding acid, methyl ester, and amino analogues) for the US. The Australian MRLs are 0.1 mg/kg for edible offal and *0.01 mg/kg for meat and milk. The Australian MRL for legume vegetables is 0.1 mg/kg.

The US EPA determined that there is no reasonable expectation of acifluorfen being detected in animal tissues on feeding at levels of up to 0.1 ppm in the diet (tissue LOQs of 0.01-0.02 mg/kg)¹¹.

The US EPA reported¹² a metabolism study on soybeans where two applications of sodium [¹⁴C]acifluorfen were made to soybeans at ~0.3 kg ai/ha/application for a total application of 0.6 kg ai/ha. The foliar applications were made to field grown soybeans at 21 and 81 days after planting. The whole aerial portion of the immature soybean plants (forage) were sampled 2-3 hours after the first and second applications and 13 days after the second application. Mature soybean seeds and fodder (including empty pods) were sampled 50 days after the second application.

¹⁰ 2003 JMPR. Pesticide Residues in Food - 2003 Evaluations – Part I: Residues, FAO Plant Production and Protection Paper xxx. FAO and WHO 2004

¹¹ SODIUM ACIFLUORFEN PC Code 114402; Case 2605 Reregistration Eligibility Decision, Residue Chemistry Considerations, March 29, 2000, Contract No. 68-W-99-053, Submitted to: U.S. Environmental Protection Agency, Arlington, VA. Submitted by: Dynamac Corporation, The Dynamac Building, 2275 Research Boulevard, Rockville, MD 20850-3268

¹² HED Metabolism Committee (MEMORANDUM: Sodium Acifluorfen (PC Code: 114402): HED Metabolism Assessment, Review Committee Decision Document (DP Barcode: D265602).
http://www.epa.gov/pesticides/reregistration/acifluorfen/metabolism_committee_report.pdf

Of the total radioactive residue (TRR), 20% and 82% was, respectively, identified and characterized in seed. Acifluorfen *per se* is the major residue identified in seed 50 days post-treatment at 8.9% of the TRR (0.043 ppm). In forage at 50 days, 27% and 53% of the TRR was identified and characterized, respectively. Similarly, in forage, acifluorfen is the major identified residue: 83% of the TRR on 0-day (28 ppm), 58% TRR on day 13 (16 ppm), and 27% TRR on day 50 (7 ppm).

In a goat metabolism study where goats were dosed at the equivalent of 10 ppm in the feed, total radioactive residues in tissues and milk ranged from 0.008 mg equiv./kg in milk to 0.40 mg equiv./kg in kidney¹³. Acifluorfen accounted for 1 to 5.2% of the TRR.

The day-0 residues in the soybean study correspond to the maximum expected at the label application rate. If residues in fodder are present at harvest (28 days after the last application) are about 4.5 ppm, residues would also be expected in tissues at about the level of the LOQ.

It is anticipated that animal product residues will be below typical method LOQs.

alpha-Cypermethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)	Harvest WHP	Feeding restraints
<i>Potatoes</i>	40	14 days	Do not allow livestock to graze treated crops for 35 days after application
<i>Asparagus, Broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, Kohlrabi, turnips</i>	40	1	-
<i>Lettuce</i>	40	3	-
<i>Sweet corn</i>	40	7	-
<i>Tomatoes</i>	40	1	-

Alpha-cypermethrin residues decline with typical half-lives of 30 and 5 days for soil and foliage respectively. The half-life for the decline of residues in animal tissues is approximately 7 days.

There are Australian, Codex and USA MRLs for cypermethrin in animal tissues. The relevant MRLs for cattle fat are 0.5, 0.2 and 1 mg/kg for Australia, Codex and the USA respectively. The milk MRLs for the same are 1 [in the fat = 0.04 mg/kg whole milk], 0.05 F mg/kg and 2.5 mg/kg respectively. The US also has separate MRLs for zeta cypermethrin of 1 mg/kg for cattle fat and 2.5 mg/kg in milk fat (reflecting a residue of 0.1 mg/kg in whole milk). The Australian PAFC MRL for cypermethrin is 5 ppm. There are Australian MRLs of 0.5, 1, 2, 1, *0.01, 0.05 and 0.5 mg/kg respectively for asparagus, brassicas, lettuce, peas, potatoes, sweet corn (corn-on-the-cob) and tomatoes.

¹³ SODIUM ACIFLUORFEN PC Code 114402; Case 2605 Reregistration Eligibility Decision, Residue Chemistry Considerations, March 29, 2000, Contract No. 68-W-99-053, Submitted to: U.S. Environmental Protection Agency, Arlington, VA. Submitted by: Dynamac Corporation, The Dynamac Building, 2275 Research Boulevard, Rockville, MD 20850-3268

The TF for fat is 0.1^{14,15}. From data presented in the 1981 JMPR evaluation for maize it is apparent that residues in sweet corn trash may be as high at 0.4-1.3 ppm. If residues in sweet corn trash are at the same level as reported by the 1981 JMPR, anticipated residues in fat are $0.4-1.3 \times 0.1 = 0.04-0.13$ mg/kg if fed at 100% of the diet. Anticipated residues in whole milk (TF 0.003-0.1) are the same as for fat.

Assuming that residues in waste fed at an appropriate proportion of the diet do not give rise to exposures of greater than 2 ppm in the diet (dry weight basis), cypermethrin residues in fat would be lower than the relevant Australian, Codex and US MRLs.

Noting the conservative assumptions used, livestock residues are not anticipated to exceed international and/or domestic market standards.

Amitrole

-is a herbicide used to control weeds in a variety of situations. The application rate for *potatoes* is up to 2.75 kg ai/ha when used as part of the preparation for harvest. No harvest WHP is required.

There are Australian but no Codex or US MRLs for amitrole in animal commodities. The Australian MRLs, including milk, have all been set at *0.01 mg/kg. The Australian MRL for potatoes is *0.05 mg/kg. As no residues are expected in potatoes at harvest, no residues are expected in potato culls or processing waste. The feeding of potatoes or processing waste derived from potatoes treated with amitrole does not represent a risk for residues in animal commodities.

The JMPR have stated that¹⁶ “*There do not appear to be any grounds for assuming that livestock grazing on plant materials growing on land that had been treated with amitrole for the control of weeds would absorb or retain significant amounts of amitrole or its metabolites*”.

It is anticipated that animal product residues will be below typical method LOQs.

Asulam

-is a herbicide used to control weeds in a variety of situations. The application for *onions* is for dock control as a spot spray and is unlikely to result in any residues. The rate for *potatoes* is 1.12 kg ai/ha.

No harvest WHP required when used as directed.

Onions: Do not graze or cut for stock food for 21 days after application

There are Australian and US but no Codex MRLs for asulam in animal commodities. The Australian MRLs have been set at T*0.1 for edible offal and T*0.01 mg/kg for milk and meat. The US MRL for animal commodities have all been set at 0.05 mg/kg except meat byproducts which is 0.2 mg/kg. The Australian MRL for potatoes is *0.01 mg/kg.

In a study reported by the US EPA¹⁷ residues were non-detectable in tissues of lactating dairy cows dosed with asulam *per se* at 0.5 ppm (tissue LOQ <0.05 mg/kg) while at higher dose rates residues

¹⁴ Chen-AW; Fink-JM; Letinski-DJ; Barrett-GP; Pearsall-JC (1997) Residue of cypermethrin and its major acid metabolites in milk and tissues from dairy bovines treated with cypermethrin. *J. Ag. Food Chem.* 45: 12, 4850-4855.

¹⁵ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

¹⁶ 1974 JMPR. Evaluations of some pesticide residues in food. FAO/AGP/1974/M/11; WHO Pesticide Residues Series No. 4, 1975

were detected in kidney. At 5 ppm feeding the residues in kidney were 0.06-0.12 mg/kg while at 50 ppm the residues in kidney were 0.11-0.13 mg/kg. Note the method measured the sum of asulam and metabolites containing the sulphanilamide moiety while the Australian definition is parent compound.

It is anticipated that animal product residues will be below typical method LOQs.

Atrazine

- is a triazine herbicide used for the control of grass and weeds in crops such as sugarcane, maize, lupins, canola and sorghum. It is applied pre-plant, pre-emergent, and post-emergent on *sweet corn* at an application rate of up to 3 kg ai/ha. It is also used on *potatoes*, after the haulm has dried at a maximum rate of 1.15 kg ai/ha.

No harvest or grazing WHPs are required.

There are no Codex animal tissue MRLs for atrazine. The US MRLs for animal tissues are lower (0.02 mg/kg for cattle fat, mbyp, meat and milk) than the Australian MRL of T*0.1 mg/kg for edible offal mammalian and T*0.01 mg/kg for milk. The US also has MRLs for corn (fresh (corn cobs with husk removed) of 0.2 mg/kg and for sweet corn fodder of 15 ppm. The Australian MRLs for sweet corn and potato are *0.1 and *0.01 mg/kg. There is an Australian primary animal feed commodity MRL of T40 ppm. Residues in soil and foliage decline with typical half-lives of 60 and 5 days respectively.

Feeding at 37.5 ppm in the diet for 28 days gave residues that were <0.01 mg/kg in milk and tissues at slaughter¹⁸. Therefore detectable residues are not expected to result from the feeding of sweet corn trash, potato culls or sweet corn and potato processing wastes to animals.

It is anticipated that animal product residues will be below typical method LOQs.

Azoxystrobin

-is a strobilurin fungicide used for control of powdery and downy mildew, sclerotinia and blights on *cucurbits*, *potatoes* and *tomatoes*. Application is at up to 30 g ai/hL.

The harvest WHP is 1 day for cucurbits and tomatoes and not required for potatoes.

There are Australian, US and Codex MRLs for animal commodities. The Australian MRLs for animal tissues have been set at *0.01 mg/kg while the milk MRL is 0.005 mg/kg. The US MRLs for animal commodities are set at 0.03, 0.01 and 0.07 mg/kg for cattle fat, meat and meat by-products respectively and 0.006 mg/kg for milk. The Codex MRL for edible offal is 0.07, meat (fat) is 0.05 and milk fat is 0.03 mg/kg. Australian MRLs have been set for cucurbits, tomatoes and potatoes at 1, 0.5 and 0.05 mg/kg respectively. There is an MRL for tomato pomace (dry) of 10 ppm as well as temporary MRLs of 10 mg/kg for pea forage, pea fodder and pea hay. The US MRLs for cucurbits, potatoes and tomatoes are 0.3, 0.03 and 0.2 mg/kg respectively.

Residues in tissues of lactating cows were ≤0.01 mg/kg after feeding at levels up to 25 ppm in the diet for 28 days¹⁹. It is not considered likely that residues from feeding tomato pomace, cucurbit or potato culls or processing waste will exceed 0.01 mg/kg in tissues.

¹⁷ Reregistration Eligibility Decision, Asulam List A Case 0265 EPA 738-R-95-024 September 1995 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.

¹⁸ Atrazine Reregistration Eligibility Decision Residue Chemistry Considerations PC Code 080803; Case 0062 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

It is anticipated that animal product residues will be below typical method LOQs.

Benalaxyl

- is a phenylamide fungicide used for the control of downy mildew and various other fungal diseases. It is used on *cucurbits* and *onions* at 0.2 kg ai/ha.

The harvest WHP is 7 days for both cucurbits and onions.

There are no Australian, Codex or US MRLs for benalaxyl in animal commodities. Benalaxyl is not registered in the US. There are EU MRLs for animal tissues, all set at *0.5 mg/kg. The Australian MRLs for cucurbits and onions are 0.2 and 0.1 mg/kg respectively.

The JMPR reported that ¹⁴C residues in tissues of goats dosed at the equivalent of 50 ppm in the diet for 7 days with ¹⁴C-benalaxyl were <0.1 mg equiv./kg in muscle, 0.4 mg equiv./kg in kidney and 1 mg equiv./kg in liver²⁰. At the likely exposure from feeding cucurbits or onions to animals there is no reasonable expectation of residues above likely LOQs of enforcement analytical methods.

It is anticipated that animal product residues will be below typical method LOQs.

Benfluralin (benefin)

-is a herbicide used for the control of grasses. It is permitted for the control of grass in *lettuce seed crops* and is applied pre-emergent at a maximum rate of 1.8 kg ai/ha.

There is no Australian or Codex or US tolerances for benfluralin in animal commodities. The MRL for lettuce is T*0.05 mg/kg.

One lactating dairy cow was orally dosed with uniformly ring-labeled [¹⁴C]benfluralin at 10 ppm in the diet for three consecutive days²¹. The TRR (expressed as benfluralin equivalents) were 0.006 ppm in milk (Day 3), 0.320 ppm in liver, 0.073 ppm in kidney, 0.004 ppm in muscle, and 0.006 ppm in fat. Milk and tissue TLC analysis indicated that the radioactive residue consisted of multiple components, none of which accounted for more than 5% of the sample TRR. Benfluralin, the parent compound was not detected in milk or tissue samples.

It is anticipated that animal product residues will be below typical method LOQs.

Bentazone

-is a benzothiadazole herbicide used for the control of certain broad-leafed weeds in *beans*. The application rate is 1.44 kg ai/ha for broad beans, green beans and navy beans. Application timing is from when the unifoliate bean leaf is fully expanded onwards. The harvest WHPs range from 5 weeks to 8 weeks. No residues data are available for bean hay/fodder.

¹⁹ APVMA Animal Residue Data Sheet – Azoxystrobin (October 2002)

<http://www.apvma.gov.au/residues/stockfeed.shtml>

²⁰ 1986 JMPR Pesticide Residues in Food - 1986 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1986

²¹ MEMORANDUM dated 28 May 2003, Benfluralin: Residue Chemistry Chapter for the Reregistration Eligibility, Decision. Bar Code No.: D267992, Case: 2030, PC Code: 084301, FROM: Richard Griffin, Biologist, Reregistration Branch II, Health Effects Division, THROUGH: Alan Nielsen, Branch Senior Scientist, Reregistration Branch II, Health Effects Division, and Chemistry Science Advisory Council, Health Effects Division, TO: Richard Griffin, Risk Assessor, Reregistration Branch II, Health Effects Division (7509C)
<http://www.fluorideaction.org/pesticides/benfluralin.may.28.03.pdf>

There are Australian and Codex but no US MRLs for bentazone in animal commodities. The Australian MRLs for tissues and milk are *0.05 mg/kg. The Codex MRL is *0.05 mg/kg for meat mammalian as is the milk MRL. The EU MRL for milk and cream is *0.02 mg/kg.

The Australian MRL for beans is *0.1 mg/kg as is the MRL for sweet corn (corn-on-the-cob). The Australian MRL for garden pea (shelled) is T*0.05 mg/kg.

Animal metabolism studies (5 to 8 day goat study, up to 1420 ppm) and a goat feeding study (35 days) at 75 and 150 ppm suggest that no detectable residues are expected with exposure of 10 to 15 ppm²². (TF for kidney was 0.04 and fat 0.002)

Note: the US EPA indicate that a lactating cow animal transfer study exists with feeding levels of 1, 5 and 20 ppm with ¹⁴C bentazone and its 6 and 8-hydroxy metabolites.

It is anticipated that animal product residues will be below typical method LOQs.

Beta-cyfluthrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on pulses, *brassicas* and *tomatoes* for the control of heliothis spp. The application rate is up to 15 g ai/ha. Cyfluthrin residues decline with typical half-lives of 60 and 3-5 days for soil and foliage respectively. Residues in cattle from pour-on application decline with a half-life of <14 days, a shorter half-life would be expected for tissue residues when animals are on “clean feed”. The harvest WHP is 1 days for tomatoes and brassicas except broccoli for which the WHP is 3 days.

There are Australian, USA and Codex MRLs for cyfluthrin. The relevant MRLs for cattle fat are 0.5, 1 and 2 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for cattle milk are 0.1, 0.04 and 5 mg/kg for milkfat (1 mg/kg in whole milk) for Australia, Codex and the USA respectively. There are Australian MRLs for brassicas and tomatoes of 0.5 and 0.2 mg/kg respectively and various forage MRLs (grass pasture, legume pasture, chickpea, field pea, canola, faba bean, navy bean, sorghum) of 2-5 mg/kg. The US has MRLs for tomato at 0.20 ppm and tomato, pomace at 5.0 ppm implying a concentration factor of 25 for processing of tomatoes to produce pomace.

Residues in the animal diet from tomato pomace would not be expected to lead to exposure of greater than $0.3 \times 25 \times 0.2 = 1.5$ ppm in the diet. TF fat = 0.05^{23} . Estimated residues in fat are $1.5 \times 0.05 = 0.075$ mg/kg. The low levels of residue anticipated in fat lead to the conclusion that feeding of tomato pomace with beta-cyfluthrin residues should not present a problem. The TF for milk is 0.005 giving anticipated residues of $1.5 \times 0.005 = 0.0075$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Bifenthrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on *tomatoes* for control of heliothis, mites and white fly. The application rate is up to 60 g ai/ha.

²² 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

²³ 1998 JECFA Residues of some veterinary drugs in animals and foods. Forty-eighth meeting of the Joint FAO/WHO Expert Committee on Food Additives, 1998, FAO Food and Nutrition Paper 41/10

Bifenthrin is also authorised for use on *sweet potato* at 6 g ai/10 0L (60 g ai/ha) and *egg plants* and *peppers* at 6 g ai/100 L. For *Brassica (cole or cabbage vegetables)*, *Common bean*, *cucurbits* and *lettuce head* the rate for white fly is 60 g ai/ha or 6 g ai/hL. Bifenthrin residues decline with typical half-lives of 26 and 7 days for soil and foliage respectively.

Tomato, pepper, egg plant, sweet potato: Do not harvest for 1 day after application.

(NOTE no grazing restraints but other field crops have a 4 week grazing/cutting for stock food restraint)

Brassica vegetables and lettuce head: Do not harvest for 7 days after application.

Common beans: Do not harvest for 2 days after application. Do not graze or feed to livestock.

Cucurbits: Do not harvest for 3 days after application.

There are Australian, Codex and USA MRLs for bifenthrin in animal tissues. The relevant MRLs for cattle fat are 2, 0.5 and 1 mg/kg for Australia, Codex and the USA respectively. The MRLs for milk are 0.5 mg/kg, *0.05 mg/kg (cattle milk) and 1 mg/kg (milk fat, 0.1 mg/kg for whole milk). The Australian MRL for tomatoes is 0.5 mg/kg. The MRL for sweet potato is *0.05 mg/kg, Brassica vegetables T1 mg/kg, Common beans T1 mg/kg and leafy vegetables T2 mg/kg. There are also MRLs for fodder and forage of pulses at 1 and 5 ppm respectively. Data for lucerne forage at 14 and 28 days after application at 60 g ai/ha were 6.8 and 4 ppm.

Assuming residues in tomato pomace do not concentrate more than 5×, pomace is fed at a maximum of 30% of the diet and a maximum TF of 0.3²⁴ would give residues in fat of 0.225 mg/kg. The TF for milk is 0.02 giving anticipated residues in milk of 0.3×2.5×0.02 = 0.015 mg/kg

Note: There may be APVMA permits for uses on eggplant, cucurbits and peppers as well as a variety of very minor crops such as herbs. The assessment above for tomatoes should cover these other crops.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Bitertanol

-is a fungicide used for the control of rust on various crops. It is used on *beans* at a maximum application rate of 150 g ai/ha.

The harvest WHP is 3 days.

There are Australian and Codex but no US tolerances for bitertanol in animal commodities. The Australian and Codex residue definition is parent compound. Bitertanol is not registered in the USA. The Australian MRLs are 3 mg/kg for edible offal (mammalian), 0.3 mg/kg for meat (mammalian) (in the fat) and 0.2 mg/kg for milk. The Codex MRLs have all been set at *0.05 mg/kg (meat mammalian, (fat), edible offal mammalian and milk). The MRL for beans is 0.5 mg/kg. There are Australian animal feed commodity MRLs of 50 ppm for bean forage (green) and bean fodder.

Transfer factors for bitertanol and its metabolites containing 1,2,4-triazole are 0.03 for liver, 0.003 for fat and 0.001 for milk²⁵. Assuming feeding forage/fodder at 100% of the diet would give rise to residues of 1.5 mg/kg for liver and 0.05 mg/kg for fat. Note this is for residues measured as bitertanol and metabolites containing 1,2,4-triazole. In a dairy cow metabolism study, the ratio of

²⁴ 1992 JMPR - Pesticide Residues in Food – 1992 evaluations. Part II. Toxicology. WHO, WHO/PCS/93.34, Geneva, 1993

²⁵ 1986 JMPR Pesticide Residues in Food - 1986 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1986

bitertanol *per se* to the sum of extracted bitertanol and identified 1,2,4-triazole containing metabolites was 0.18 for liver, 0.16 for kidney, 0.18 for muscle, 0.42 for fat and 0.35 for milk.

Livestock residues may exceed international and/or domestic market standards.

Boscalid

-is an oxathiin fungicide used for control of sclerotinia fungal diseases in vegetables (APVMA permits). Application is at up to 500 g ai/ha.

Brassica and brassica leafy vegetables: Do not harvest for 7 days after application.

Lettuce – Do not harvest for 14 days after application

Beans - Do not harvest for 7 days after application.

Codex MRLs for boscalid (recommended 2009) are meat (fat) 0.7 mg/kg, edible offal 0.2 mg/kg and milks 0.1 mg/kg (milk fat 2 mg/kg). The Australian MRLs are 0.3 mg/kg for edible offal mammalian, 0.3 mg/kg for meat [mammalian][in the fat] and 0.1 mg/kg for milks (0.7 mg/kg milk fat). The US MRLs are 0.35 mg/kg for meat by-products, 0.3 mg/kg for fat and 0.1 mg/kg for milk (residue definition boscalid + glucuronide conjugate). There are Australian MRLs of T2 mg/kg for boscalid in Brassica (cole or cabbage) vegetables, Head cabbages, flowerhead brassicas and T10 mg/kg for Brassica leafy vegetables, T15 mg/kg for lettuce head and lettuce leaf and T3 mg/kg for beans.

In a cow transfer study, fourteen dairy cows were fed 0, 0.05, 0.164 and 0.655 mg/kg bw of boscalid once daily for 28 days²⁶. The highest residues of boscalid were noted to be present in the cream, kidney, fat and liver of cows dosed at 0.655 mg/kg bw at levels of 0.381, 0.318, 0.292 and 0.182 mg/kg respectively. Residues of 0.096 mg/kg were detected in whole milk on day 18 of the study. No residues were detected in skim milk. Residues of 0.058 mg/kg were detected in the muscle of the cow after feeding for 28 days.

Depuration data were given for a single cow, sacrificed 7 days following dosing at 0.655 mg/kg bw in the feed. The data show that quantifiable residues were not detected in the milk, muscle, liver, kidney and fat of the cow. Boscalid is rapidly depleted from the cow after removing the animal from dosing for 7 days.

Health Canada²⁷ indicated the above dose rates (mg/kg bw) were equivalent to feeding at 1.8, 5.9 and 20 ppm in the diet giving rise to estimated transfer factors of 0.019 for cream, 0.016 for kidney, 0.015 for liver, 0.009 for fat and 0.003 for muscle.

Feeding at Brassica vegetables with residues of 10 ppm is expected to give rise to residues of boscalid of $10 \times 0.016 = 0.16$ mg/kg in kidney and $10 \times 0.009 = 0.09$ mg/kg for fat.

Residues in cream would be 0.19 mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Bromacil

²⁶ Public Release Summary on Evaluation of the new active BOSCALID in the product FILAN FUNGICIDE, Australian Pesticides and Veterinary Medicines Authority, April 2004, Canberra, Australia

²⁷ Health Canada, PMRA Regulatory Note REG2004-02 Boscalid/BAS 510, 30 January 2004

- is a selective herbicide used for the control of certain broad leaved weeds and grasses in *asparagus*. It is applied to grass/weeds before spear emergence and later following cultivation in the growing crop. The application rate is up to 2 kg ai/ha.
No harvest WHP required.

There are no Codex or USA MRLs for bromacil. The Australian MRLs are *0.04 mg/kg for meat (mammalian), edible offal (mammalian) and milk. In fact all MRLs for bromacil including asparagus have been set at *0.04 mg/kg implying that no residues are expected. No detectable residues are expected to result from the feeding of asparagus waste to animals.

It is anticipated that animal product residues will be below typical method LOQs.

Bupirimate

-is a pyrimidine fungicide. It is used to control powdery mildew in *cucurbits* with application at a maximum rate of 15 g ai/hL. The harvest WHP is 1 day.

There are no Australian, Codex or US MRLs for bupirimate in animal commodities. The Australian MRL for cucurbits is 1 mg/kg and for peppers 0.7 mg/kg.

EFSA reported a study where a lactating goat was dosed with ¹⁴C-bupirimate for 7 days at a level equivalent to 4.4 ppm in the diet. The goat was sacrificed 4 hours after the last dose. Residues in milk reached a plateau on day 4 at 0.07-0.09 mg eq/kg. Radioactivity in tissues were 0.09 mg eq/kg for liver, 0.1 for kidney and <0.01 mg eq/kg for fat and muscle.

It is anticipated that animal product residues will be below typical method LOQs.

Buprofezin

is an insecticide used for the control of silver-leaf whitefly in *cucumbers*, *zucchini*, *eggplants* and *tomatoes* (APVMA permit 6056). The application rate is 26.4 g ai/hL.
The harvest WHP is 3 days

There are Australian, US and Codex MRLs for buprofezin in animal commodities. The Australian and US MRLs for edible offal and meat (fat) are all *0.05 mg/kg and for milk *0.01 and 0.01 mg/kg respectively. The Codex MRL for animal tissues is *0.05 and MRL for milk is *0.01 mg/kg. The Australian MRLs are T2 for eggplant and tomato and T0.5 mg/kg for summer squash and cucumber.

The JMPR reported a PF of 34 for tomatoes to pomace (dry). Residues of buprofezin were not detected in the tissues of cows following dosing at rates equivalent to feeding levels of 5, 15 and 50 ppm in the diet²⁸. The method LOQ was 0.05 mg/kg

It is anticipated that animal product residues will be below typical method LOQs.

Butoxydim

- is a selective herbicides used for the control of certain grass weeds in various vegetables (brassica and brassica leafy vegetables, carrot, celery, onion, parley, parsnip, coriander and lettuce under an APVMA permit. It is applied to grass weeds in crop. The application rate is up to 45 g ai/ha.
Seed from treated produce may only be used for the purposes of replanting

²⁸ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

All other produce must be disposed of in such a manner so as to not result in human or animal consumption.

There are no Codex or USA MRLs for butoxydim. The Australian residue definition for butoxydim is parent compound. The Australian MRLs are *0.01 mg/kg for meat (mammalian), edible offal (mammalian) and milk. In fact all MRLs for butoxydim (oilseeds, legume vegetables, pulses) have been set at *0.01 mg/kg implying that no residues are expected. No detectable residues are expected to result in animal tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Cadusafos

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *tomatoes* for application at planting. The application rate is up to 10 kg ai/ha. No harvest or grazing WHPs are required.

There are no Australian, Codex and USA MRLs for cadusafos in animal tissues despite MRLs having been set for crops. The Australian use-pattern is for application at planting and as such residues are not expected in tomatoes at harvest. This is reflected in the Australian MRL for tomatoes of *0.01 mg/kg. Therefore no residues are expected to result from the feeding of tomato pomace, culls or processing wastes to animals.

It is anticipated that animal product residues will be below typical method LOQs.

Carbaryl

- is a carbamate insecticide used for the control of various insects in crops. It is registered on *vegetables* for control of caterpillars, moths and weevils etc. The application rate is up to 1.1 kg ai/ha.

Do not harvest for 3 days after application.

Carbaryl residues decline with typical half-lives of 10 and 7 days for soil and foliage respectively.

There are Australian, Codex and USA MRLs for carbaryl in animal tissues. The Australian and Codex residue definition is carbaryl for both plant and animal commodities. The Australian MRLs for edible offal and meat are T0.2 mg/kg while that for milk is T*0.05 mg/kg. The Codex MRL for kidney is 3 mg/kg and liver 1 mg/kg while the MRL for meat is 0.05 mg/kg. The Codex milk MRL is 0.05 mg/kg. The Australian MRLs are 10 mg/kg for asparagus, leafy vegetables, okra, 3 mg/kg for cucurbits, 0.2 mg/kg for potato, 1 mg/kg for sweet corn (corn-on-the-cob) and 5 mg/kg for other vegetables.

The USA residue definition is the sum of carbaryl and 1-naphthol expressed as carbaryl for plant commodities, the sum of carbaryl, 1-naphthol, 5,6-dihydrodihydroxycarbaryl and 5,6-dihydrodihydroxynaphthol expressed as carbaryl for animal tissues. The US tolerance for cattle meat byproducts is 3 mg/kg and that for meat and milk 1 mg/kg.

Maximum residues for cabbage, tomato, peppers and carrots reported in the 2002 JMPR (and scaled for the Australian use-pattern) were 1.8, 1.2, 1.9 and 0.3 mg/kg respectively. The 2002 JMPR also reported processing factors for tomato pomace (dry) and sweet corn cannery waste of 2.9 and 74 respectively.

The TF for kidney is 0.007 for the Australian/Codex residue definition and 0.012 for the US residue definition²⁹ giving rise to anticipated maximum residues in kidney from feeding sweet corn cannery waste fed at 100% diet of $0.007 \times 1 \times 74 = 0.5$ mg/kg and $0.012 \times 1 \times 74 = 0.9$ mg/kg respectively for the Australian/Codex and USA residue definitions.

The TF for milk is 0.0002 for the Australian/Codex residue definition and 0.002 for the US residue definition giving rise to anticipated maximum residues in milk from feeding sweet corn cannery waste at 100% of the diet of $0.0002 \times 1 \times 74 = 0.015$ mg/kg and $0.002 \times 1 \times 74 = 0.15$ mg/kg respectively for the Australian/Codex and USA residue definitions.

Livestock residues may exceed international and/or domestic market standards.

Carbendazim

- is a carbamate fungicide used for the control of fungal diseases in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)	Harvest WHP	Feeding restraints
<i>Cucurbits</i>	225 g ai/ha or 25 g ai/hL	-	-

Benomyl/carbendazim residues decline with typical half-lives of 60 and 3-5 days for soil and foliage respectively.

There are Australian but no Codex or USA MRLs for carbendazim. The relevant MRLs for cattle meat are 0.2 mg/kg for Australia while the milk MRL is *0.1 mg/kg. There are Australian MRLs for cucurbits other than melons (2 mg/kg) and melons (4 mg/kg), for fruiting vegetables other than cucurbits 2 mg/kg and for other vegetables at 3 mg/kg. The animal feed MRL for legume animal feeds is 25 ppm.

In studies in which dairy cows were fed either carbendazim or benomyl at levels of 2, 10, or 50 ppm in the diet for 28 days, no benomyl residues were found in samples of lean muscle, liver, kidney or fat although in the carbendazim feeding study low-level residues of 5-HBC were observed in the liver (0.01 mg/kg) and kidneys (0.06 mg/kg) of cows in the group receiving 50 ppm carbendazim³⁰. However, residues of this compound were also apparent in a kidney sample in the control group. One week after the end of treatment with the test material no residues were detectable in any tissue sample.

Considering the exaggerated feeding levels, it is unlikely that feeding of culms and vegetable waste derived from crops treated with carbendazim would result in residues above LOQ in tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Chlorantraniliprole

- is an insecticide for the control of various pests on vegetables.

Crop	Rate	WHP
Brassica vegetables (including broccoli, Brussels sprouts,	20 g ai/ha	7 days

²⁹ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

³⁰ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999.

cabbage, cauliflower)		
Brassica leafy vegetables (including Buk choy, Chinese broccoli, Chinese cabbage, Choy sum, Gai choy/Am soy, Kai choy, Kale, Mibuna, Leafy mustard Indian mustard and mustard spinach (Komatsuma). Pak choy, tat soy)	20 g ai/ha	3
Stalk and stem vegetables (including celery, rhubarb)	20 g ai/ha	3
Leafy vegetables (including cress, endive, silverbeet, spinach but NOT lettuce)	20 g ai/ha	3
Lettuce	30 g ai/ha	3
Fruiting vegetables (capsicum, eggplant, peppers, tomato but excluding cucurbits)	20 g ai/ha	3
Cucurbits (cucumbers, melons, pumpkins, squash, zucchini)	20 g ai/ha	3
Potatoes	20 g ai/ha	-

Do not graze or cut for stock food.

There are Australian, Codex and US MRLs for chlorantraniliprole. The relevant Australian MRLs for meat (fat), edible offal and milk are all *0.01 mg/kg. The US MRLs are 0.3 mg/kg for fat and liver, 0.2 for cattle mbyp (=offal) except liver, 0.05 mg/kg for meat and milk. The Codex MRLs are all *0.01 mg/kg (meat (fat), offal and milk).

The Australian MRLs are: brassica vegetables 0.3 mg/kg, celery 5 mg/kg, fruiting vegetables, cucurbits 0.2 mg/kg, fruiting vegetables other than cucurbits (except chilli) 0.3 mg/kg, leafy vegetables except head lettuce and rucola 15 mg/kg, head lettuce 3 mg/kg, chilli peppers 1 mg/kg and potatoes *0.01 mg/kg.

The 2008 JMPR reported a feeding study where dairy cows were dosed with chlorantraniliprole for 28 days at the equivalent of 1, 3, 10 and 50 ppm in the diet. Average residues of chlorantraniliprole in milk for the 3 ppm dose group were < 0.01 (3) mg/kg. Chlorantraniliprole residues in liver and fat were higher than in other tissues. Average residues for tissues for the 3 ppm dosing level (3 animals per dose group) were all < 0.01 mg/kg for liver, fat, kidney and muscle. A transfer factor of $<0.01/3 = <0.003$ for fat when fed at 3 ppm in the diet was reported. When fed at 30% of the diet residues would need to be > 10 ppm (dry weight basis) in the feed item for residues above 0.01 mg/kg.

A transfer factor of 0.003 for milk when fed at 3 ppm in the diet was reported. Applying this TF to the Australian MRL for leafy vegetables at 30% of the diet gives a milk residue of 0.015 mg/kg ($0.3 \times 15 \times 0.003$).

It is anticipated that animal product residues will be below typical method LOQs for vegetables other than leafy vegetables including head lettuce and celery.

Chlorfenapyr

- is a pyrrole insecticide/miticide. It is used on *Brassica vegetables* for the control of diamond back moth and cabbage butterfly. The application rate is 0.144 kg ai/ha. The harvest WHP is 7 days. Do not feed treated vegetables to animals.

There are Australian but no Codex or US MRLs (revoked 31/1/2001) for chlorfenapyr. The relevant Australian MRLs for meat (fat), edible offal and milk are 0.05, *0.05 and *0.01 mg/kg respectively. The revoked US MRLs were 0.1 mg/kg for cattle fat, 0.3 for cattle mbyp (=offal), 0.01 mg/kg for meat and 0.01 mg/kg for milk.

The Australian use-pattern is such that residues are expected in brassicas at harvest and therefore also in waste fed to animals. The Australian MRL for Brassica (cole or cabbage) vegetables, head cabbages, flowerhead brassicas is 0.5 mg/kg.

A transfer factor of 0.09 for fat when fed at 7 ppm in the diet was reported³¹. Applying this TF to the Australian MRL for brassicas fed at 100% of the diet gives a fat residue of 0.045 mg/kg (0.5×0.09). Decline information suggests a half-life of approximately 4 days for fat. A transfer factor of 0.006 for milk when fed at 7 ppm in the diet was reported. Applying this TF to the Australian MRL for brassicas fed at 100% of the diet gives a milk residue of 0.003 mg/kg (0.5×0.006).

It is anticipated that animal product residues will be below typical method LOQs.

Chloridazon

-is a herbicide for the control of various annual and broad leafed weeds in *red beet*, *silver beet* and *fodder beet* crops. It is applied pre-emergent at a maximum rate of 520 g ai/ha. No harvest WHP required.

There are no Australian, Codex or US tolerances for chloridazon in animal tissues. The Australian MRL for beetroot is *0.05 mg/kg. As no residues are expected in the animal feed commodity there is no reasonable expectation of residues in animal commodities.

It is anticipated that animal product residues will be below typical method LOQs.

Chloropicrin

Predominantly used as a pre-harvest soil fumigant, either alone (Chloropicrin or Telone) or with MeBr. Table 5 entry for Telone use patterns (1,2 dichloropropane; 1,3-dichloropropene). No detectable residues are expected from the use patterns.

It is anticipated that animal product residues will be below typical method LOQs.

Chlorothalonil

- is a systemic fungicide used for the control of various fungal diseases in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP	Feeding restraints
<i>Beans</i>	1.7	7	-
<i>Peas, carrots</i>	1.3	7	-
<i>Artichokes, capsicums (peppers), endive, leeks, okra, radish, sweet corn, tomato, watercress</i>	1.7	1	-
<i>Brassicas (broccoli, Brussels sprouts, cabbage, cauliflower)</i>	2.5	7	-
<i>Celery</i>	1.7	1	-
<i>Potato</i>	1.7	-	-

³¹ MEMORANDUM dated 10 March 1997, Chlorfenapyr - 129093: Health Effects Division Risk Characterization for Use of the New Chemical Chlorfenapyr in/on Cotton (5F4456). PRATS Case Number: 286152, PRATS DP Barcode numbers: D225998, D229102, & D232519, FROM: Barbara Madden, Chemical Manager, and Felecia Fort, Chemist Registration Section, Risk Characterization and Analysis Branch, Health Effects Division (7509C), THROUGH: Michael Metzger, Chief, Risk Characterization and Analysis Branch, Health Effects Division (7509C) and Margaret J. Stasikowski, Director, Health Effects Division (7509C), TO: Meredith Johnson/Dennis Edwards, PM-19, Insecticide Rodenticide Branch, Registration Division (7505C)) <http://www.epa.gov/opprd001/chlorfenapyr/memohed2.pdf>

<i>Onions</i>	1.7	14	-
<i>Cucurbits</i>	1.8	1	-

There are Australian and US but no Codex MRLs for chlorothalonil. The Australian residue definition is the sum of chlorothalonil and 4-hydroxy-2,5,6-trichloroisophthalonitrile metabolite expressed as chlorothalonil. The Australian MRLs are 7 mg/kg for edible offal, 2 mg/kg for meat in the fat and 0.05 mg/kg for milk. The US residue definition for animal commodities is 4-hydroxy-2,5,6-trichloroisophthalonitrile. The relevant MRLs for cattle commodities are 0.1, 0.5, 0.05 and 0.03 mg/kg for fat, kidney, meat by-products (except kidney) and meat respectively. The US MRL for milk is 0.1 mg/kg. There are Australian MRLs of 7 mg/kg for Brussels sprouts, carrots, of 10 mg/kg for celery, leek, onion, and tomato and 0.1 mg/kg for potato. MRL 10 mg/kg for leafy vegetables and 7 mg/kg for other vegetables not otherwise specified. There is an MRL for pea hay or pea fodder dry of 250 ppm.

The TF for kidney (target tissue, US residue definition) is 0.09^{32} . Assuming residues of chlorothalonil do not concentrate in tomato pomace or vegetable wastes, anticipated residues in kidney would be $10 \times 0.09 = 0.9$ mg/kg if fed at 100% of the diet, higher is dry matter content is accounted for. In three trials reported by JMPR residues at 14 days after the last of 8 applications at 1.3 kg ai/ha were 8.2-58 ppm in sweet corn forage. Feeding forage at 100% of the diet would lead to residues of $58 \times 0.09 = 5.2$ mg/kg in kidney. Residues were not detected in tissues after a period of 32 days on clean feed (earliest clean-feed slaughter period, feed level 250 ppm chlorothalonil + 2 ppm metabolite). Countries other than the US would be expected to utilise parent compound in any monitoring and no residues of parent compound are expected in animal tissues from feeding vegetables and their waste by-products.

The TF for milk (US def) is 0.03. Assuming residues of chlorothalonil are the same as outlined above, anticipated residues in milk from feeding tomato pomace or vegetable wastes are $10 \times 0.03 = 0.3$ mg/kg and for feeding of sweet corn forage $58 \times 0.03 = 1.7$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Chlorothalonil can contain up to 100 mg/kg hexachlorobenzene (HCB), an application rate of 2.5 kg ai/ha (Brassica's) corresponds to application of HCB at 0.25 g/ha. Several estimates of the potential for transfer of HCB residues are given below:

(a) Soil uptake. Noting the half-life for HCB in soil is 3-6 years. Uptake of HCB by various crops was such that the ratio of soil to crop residues ranges from 0.03 – 2.4 for aerial parts. The contribution from previous years applications (assumed 12 years of additions 1 spray per year at the maximum rate = 0.25 g HCB/ha = 3 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be $3000 \text{ mg} / 2000000 \text{ kg} = 0.0015$ ppm. Residues in aerial plant parts would account for no more than 0.0036 mg/kg assuming a crop to soil ratio of 2.4.

Feeding vegetable culls/waste with residues at 0.0036 ppm at 100% diet would give rise to residues of $0.0036 \times 8 = 0.029$ mg/kg in fat and $0.0036 \times 8.4 = 0.030$ mg/kg in milk fat.

(b) Foliar – sweet corn. If assume chlorothalonil residues in sweet corn/maize forage at day 0 from application of a pesticide at 1 kg ai/ha are 80 ppm and scale for application rate, forage residues are expected to be $0.00017 \times 80 = 0.0136$ ppm for HCB. Feeding sweet corn forage/trash with residues at 0.0136 ppm at 100% diet would give rise to residues of $0.0136 \times 8 = 0.11$ mg/kg in fat and $0.0136 \times 8.4 = 0.11$ mg/kg in milk fat.

(c) Foliar – brassicas. If assume residues in Brassica vegetables at day 0 from application of a pesticide at 1 kg ai/ha are 40 ppm and scale for application rate, forage residues are expected to be

³² Pesticide Residues in Food - 1997 evaluations, FAO Plant Production and Protection Paper 146. FAO and WHO 1998

$0.00025 \times 40 = 0.01$ ppm for HCB. Feeding Brassica waste with residues at 0.01 ppm at 100% diet would give rise to residues of $0.01 \times 8 = 0.08$ mg/kg in fat and $0.01 \times 8.4 = 0.084$ mg/kg in milk fat.

Livestock residues (HCB) may exceed international and/or domestic market standards.

Chlorpropham

-is a potato sprouting inhibitor. It is applied post-harvest at 3 kg ai/100 tonnes of *potato*.

There are Codex and US but not Australian MRLs for chlorpropham in animal tissues. The US tolerance for cattle kidney and milk is 0.3, meat and meat byproducts is 0.06 mg/kg. The Codex MRL for cattle fat, edible offal and milk is 0.1, *0.01 and *0.0005 F mg/kg respectively. The Australian MRL for potatoes is 30 mg/kg.

Maximum residues in processed wet peel from treated potatoes reported by the 2001 JMPR was 45 ppm. Assuming 15% dry matter content would give a residue of 300 ppm on a dry weight basis. The maximum residue in fat of dairy cows fed at 322 ppm in the diet for 28 days was 0.13 mg/kg³³.

Livestock are unlikely to be fed potato culls or processing waste at more than 10% diet leading to anticipated residues below the LOQ.

Chlorpyrifos

- is an organophosphate insecticide used for the control of various insects in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP	Feeding restraints
<i>Capsicum</i>	0.35	3	
<i>Carrots</i>	0.35	-	-
<i>Cassava</i>	0.35	-	-
<i>Cole crops (including broccoli, cabbages etc)</i>	1	5	-
<i>Cucurbits</i>	25 g ai/hL	5	-
<i>Potatoes</i>	3	-	-
<i>Silverbeet</i>	0.15	-	-
<i>Tomatoes</i>	1	3	-
<i>Vegetables (early season uses)</i>	0.4	- (asparagus, celery 14 days)	-

The label states that the Meat Research Corporation determined that an Export Animal Feed Interval was not required.

There are Australian, Codex and USA MRLs for chlorpyrifos in animal tissues. The Australian and Codex residue definition is chlorpyrifos while the USA definition includes the metabolite TCP. The MRLs for cattle fat are T0.5, 1 and 0.3 mg/kg for Australia, Codex and the USA respectively. The MRLs for milk are T0.2 [milk in the fat] mg/kg, 0.02 mg/kg and 0.01 mg/kg (0.25 mg/kg for milk fat). There are Australian MRLs of T0.5 mg/kg for asparagus, Brassica vegetables and tomatoes, T*0.02 mg/kg for cassava, T5 mg/kg for celery and leeks, 0.05 mg/kg for potatoes and taro, capsicum T1 mg/kg and T*0.01 mg/kg for other vegetables.

³³ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

The maximum transfer factor for feeding cattle at 10 ppm in the diet was 0.016 for cattle fat³⁴. Residues from feeding vegetables with residues of 5 ppm (highest MRL) would be $5 \times 0.016 = 0.08$ mg/kg, below the Australian, Codex and USA MRLs for fat. Anticipated residues for milk would be $5 \times 0.0007 = 0.0004$ mg/kg.

PF for tomato waste is 4.2; if applied to tomato MRL of 0.5 mg/kg, dietary exposure would be $0.3 \times 4.2 \times 0.5 = 0.6$ ppm if tomato waste is included at 30% of the livestock diet, and residues in fat $0.6 \times 0.016 = 0.0096$ mg/kg. Anticipated residues for milk would be $0.6 \times 0.0007 = 0.00042$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Chlorthal-dimethyl

- is a pre-emergent herbicide. It is registered on *vegetables* (eg Brassica vegetables, beans, peas, turnips, onions, potatoes and carrots) for the control of various weeds at application rates of up to 11.25 kg ai/ha at seeding or at the time of planting.

WHP is not required when used as directed.

There are Australian but not Codex or US MRLs for chlorthal-dimethyl.

The Australian MRLs for animal tissues have all been set at *0.05 mg/kg. There is an MRL at 5 mg/kg for vegetables except lettuce which is T1 mg/kg.

In a goat metabolism study the TF for fat was 0.0003³⁵. If it is assumed that the maximum exposure for animals arises from feeding at 5 ppm in the diet (vegetable MRL) maximum anticipated residues in fat are $5 \times 0.0003 = 0.0015$ mg/kg. Although more information on likely residues in animals is desirable for chlorthal-dimethyl it is considered unlikely that this pesticide would give rise to detectable residues.

It is anticipated that animal product residues will be below typical method LOQs.

Chlorthal-dimethyl can contain up to 100 mg/kg hexachlorobenzene (HCB), an application rate of 11.25 kg ai/ha corresponds to a potential application of HCB at 1.125 g/ha.

Note the half-life for HCB in soil is 3-6 years. Uptake of HCB by various crops was such that the ratio of soil to crop residues ranges from 0.03 – 2.4 for aerial parts. The contribution from previous years applications (assumed 12 years of additions 1 spray per year at the maximum rate = 1125 g HCB/ha = 13.5 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be $13500 \text{ mg} / 2000000 \text{ kg} = 0.0068$ ppm. Residues in aerial plant parts including seed would account for no more than 0.016 mg/kg assuming a crop to soil ratio of 2.4 giving rise to anticipated residues of $0.016 \times 8 = 0.13$ mg/kg in fat and $0.016 \times 8.4 = 0.14$ mg/kg in milk fat.

EFSA reported a feeding trial where two Jersey-Holstein× dairy cows were fed a diet containing 200 ppm chlorthal-dimethyl, 40 ppm TPA, 4 ppm MPA and 1 ppm HCB or 20 ppm chlorthal-dimethyl, 0.4 ppm TPA, 0.4 ppm MPA and 0.1 ppm HCB for 24 days. Residues were monitored in milk during the study period and in biopsies of body fat sampled after 24 days of exposure and also after 12 days on “clean” feed.

³⁴ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

³⁵ Reregistration Eligibility Decision (RED) DCPA List A Case 0270 Environmental Protection Agency Office of Pesticide Programs, Special Review and Reregistration Division, EPA 738-R-98-005, November 1998

Residues in milk on feeding 200 ppm chlorthal-dimethyl

Day	Residues (mg/kg)			
	Chlorthal-dimethyl	MPA	TPA	HCB
1	nd	nd	Nd	nd
4	0.05	0.06	Nd	0.04
8	0.04	0.07	Nd	0.05
12	0.02	0.06	Nd	0.15
16	0.02	0.02	0.03	0.10
20	0.02	0.04	Nd	0.10
24	nd	0.02	Nd	0.26
1	nd	nd	Nd	0.18
3	nd	nd	Nd	0.16
5	nd	nd	Nd	0.20
7	nd	nd	Nd	0.12
9	nd	<0.01	<0.01	0.10
12	nd	0.01	0.01	0.13

At 24 days of exposure, residues in fat were <LOD for chlorthal-dimethyl and TPA but 0.26 mg/kg for MPA and 0.32 mg/kg for HCB. After 12 days on clean feed the only residues detected in fat were HCB at 0.01 mg/kg.

Livestock residues (HCB) may exceed international and/or domestic market standards.

Clethodim

- is a cyclohexanedione herbicide used for the control of certain grass weeds in crops. It is registered on *beetroot, cabbage, lettuce, potato, celery* and *onions* with a maximum application rate of 120 g ai/ha.

The harvest WHPs are 7 days for beetroot and cabbage, 14 days for onions, 4 weeks for lettuce and potatoes and 9 weeks for celery.

No grazing restraints required when used as directed

There are Australian, Codex and US MRLs for clethodim. The Australian and Codex residue definition is clethodim and its metabolites containing 5-(2-ethylthiopropyl)cyclohexane-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexane-3-one moieties and their sulphoxides and sulphones, expressed as clethodim. The US residue definition is clethodim and its metabolites containing the 2-cyclohexen-1-one moiety. The Australian MRLs for animal commodities have been set at *0.05 mg/kg. The Codex MRLs are *0.2 mg/kg for edible offal and meat and *0.05 mg/kg for milk. The US MRLs for cattle tissues are all 0.2 mg/kg and 0.05 mg/kg for milk.

The Australian MRLs applicable for Asparagus, lettuce, potato, celery and onions are 1, 0.2, 1, 0.1 and 0.3 mg/kg respectively. MRL for brassicas, head cabbages and flowerhead brassicas is 0.5 and for root vegetables 1 mg/kg.

The TF for the US residue definition is 0.006 for offal³⁶ giving an anticipated residue when using the highest vegetable MRL as the maximum feed level of $1 \times 0.006 = 0.006$ mg/kg for liver and kidney, below the US MRL.

Anticipated residues in milk (TF 0.0011) are $1 \times 0.0011 = 0.0011$ mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Clomazone

³⁶ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

- is an isoxazolidinone herbicide used to control broad leafed annual weeds in crops. It is registered for use on *cucurbits*, *green beans*, *navy beans* and *potatoes* with application made post-planting but pre-emergent at rates up to 480 g ai/ha.

A harvest WHP is not required.

The following grazing restraint appears on the label:

Do not graze or cut for stock food until after harvest.

There are no Australian, Codex or US MRLs for clomazone in animal commodities. The Australian MRLs for vegetables are all set at *0.05 mg/kg.

No detectable residues are expected to be found in any vegetable crop at harvest, following pre-emergent application of clomazone.

It is anticipated that animal product residues will be below typical method LOQs.

Cyanazine

-is a triazine herbicide used for the control of various weeds. It is registered in Australia for use on *processing peas*, *onions*, *potatoes* and *sweet corn* at applications up to 2 kg ai/ha.

Harvest WHP not required.

There are no Australian, Codex or US tolerances for cyanazine in animal commodities. The Australian MRLs for peas, onions, potatoes and sweet corn are 0.02, *0.02, 0.02 and *0.02 mg/kg.

The log P_{ow} for cyanazine is 2.2. From empirical relationships between TFs and log P_{ow} it is concluded that the TFs for cyanazine are less than 0.17 for fat, 0.02 for milk and 0.064 for offal.

It is anticipated that animal product residues will be below typical method LOQs.

Cyfluthrin (beta-cyfluthrin)

- is a synthetic pyrethroid insecticide used for the control of various insects in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Brassica vegetables</i>	15	1 except broccoli 3 days	-
<i>Brassica vegetables</i>	3.75 g ai/ha	7	-
<i>Tomatoes</i>	15	1	-
<i>Eggplant, okra, capsicums</i>	1.5 g ai/hL	1	-
<i>Beans</i>	3.75 g ai/hL	1	-
<i>Peas</i>	3.75 g ai/hL	7	-

Cyfluthrin residues decline with typical half-lives of 60 and 3-5 days for soil and foliage respectively. Residues in cattle from pour-on application decline with a half-life of <14 days, a shorter half-life would be expected for tissue residues when animals are on “clean feed”.

There are Australian, USA and Codex MRLs for cyfluthrin. The relevant MRLs for cattle fat are 0.5, 1 and 2 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for cattle milk are 0.1, 0.04 and 5 mg/kg for milk fat (1 mg/kg in whole milk) for Australia, Codex and the

USA respectively. There is an Australian MRL for Brassica vegetables at 0.5 mg/kg and for tomatoes at 0.2 mg/kg, legume vegetables 0.5 mg/kg, okra and sweet peppers 0.2 mg/kg as well as cereal grain and various forage MRLs (grass pasture, legume pasture, chickpea, field pea, canola, faba bean, navy bean, sorghum) of 2-5 mg/kg. The US has MRLs for tomato at 0.20 ppm and tomato, pomace at 5.0 ppm implying a concentration factor of 25 for processing of tomatoes to produce pomace.

Residues in the animal diet from tomato pomace would not be expected to lead to exposure of greater than 1.5 ppm in the diet (feeding of pomace with residues of 5 ppm at 30% of the diet). TF fat = 0.05. Estimated residues in fat are $1.5 \times 0.05 = 0.075$ mg/kg. The low levels of residue anticipated in fat lead to the conclusion that feeding of tomato pomace with beta-cyfluthrin residues should not present a problem.

The TF for milk is 0.005 giving anticipated residues of $1.5 \times 0.005 = 0.0075$ mg/kg.

The TF for fat = 0.05^{37} . Estimated residues in fat from feeding vegetables and waste with residues at the MRL at 100% of the diet are $0.5 \times 0.05 = 0.025$ mg/kg. The low levels of residue anticipated in fat lead to the conclusion that feeding of vegetables and vegetable waste from vegetables treated with cyfluthrin should not present a problem. The TF for milk is 0.005 giving anticipated residues of $0.5 \times 0.005 = 0.0025$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Cypermethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Brassica vegetables</i>	80	1	-
<i>Chinese cabbage</i>	80	1	-
<i>Turnips</i>	80	1	-
<i>Sweet corn</i>	100	7	-
<i>Tomatoes</i>	80	1	-

Cypermethrin residues decline with typical half-lives of 30 and 5 days for soil and foliage respectively. The half-life for the decline of residues in animal tissues is approximately 7 days.

There are Australian, Codex and USA MRLs for cypermethrin in animal tissues. The relevant MRLs for cattle fat are 0.5, 0.2 and 1 mg/kg for Australia, Codex and the USA respectively. The respective milk MRLs are 1 [in the fat = 0.04 mg/kg whole milk], 0.05 F mg/kg and 2.5 mg/kg for Australia, Codex and the USA.

There are Australian MRLs of 1 mg/kg for Brassica vegetables, 15 mg/kg for leafy vegetables, 0.05 mg/kg for sweet corn (corn-on-the-cob) and 0.5 mg/kg for tomatoes.

Note from data on maize presented in the 1981 JMPR evaluation it is apparent that residues in sweet corn trash may be as high at 2 or 3 ppm. The Australian PAFC MRL for cypermethrin is 5

³⁷ Residues of some veterinary drugs in animals and foods. Forty-eighth meeting of the Joint FAO/WHO Expert Committee on Food Additives, 1998, FAO Food and Nutrition Paper 41/10

ppm. The TF for fat is 0.1^{38,39}. If residues in sweet corn trash are at the same level as reported by the 1981 JMPR, anticipated residues in fat are $2-3 \times 0.1 = 0.2-0.3$ mg/kg if fed at 100% of the diet. Anticipated residues in whole milk (TF 0.003-0.1) are also 0.2-0.3 mg/kg.

Noting the conservative assumptions, livestock residues are not anticipated to exceed international and/or domestic market standards.

Cyproconazole

- is used as fungicide to control leaf blot and target blight in *potatoes*. The application rate is 25 g ai/ha.

No harvest WHP is required.

There are Australian and US but no Codex MRLs for cyproconazole in animal commodities. The Australian MRLs have been set at *0.01 mg/kg for milk, 1 mg/kg for edible offal and 0.03 mg/kg for meat. The US tolerance for cattle tissues except liver is 0.01 mg/kg. The potato MRL is *0.02 mg/kg. There is no reasonable expectation of residues above LOQ or LOD in animal commodities. (The log P_{ow} for cyproconazole is reported to be 2.9 indicating little propensity for transfer to fat.)

It is anticipated that animal product residues will be below typical method LOQs.

Deltamethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on *Brassica vegetables* (cabbages, broccoli etc), *sweet corn* and *tomatoes*. The application rate is up to 13.75 g ai/ha. Deltamethrin residues decline with typical half-lives of 7 and 4-8 days for soil and foliage respectively. The half-life for the decline of residues in animal tissues is approximately 7-10 days.

The harvest WHPs are 2 days for Brassica vegetables, 5 days for sweet corn and 3 days for tomatoes

There are no grazing restraints

There are Australian, Codex and USA MRLs for deltamethrin in animal tissues. The relevant MRLs for cattle fat are 0.5, 0.5 and 0.05 mg/kg for Australia, Codex and the USA respectively. The Australian MRL for milks is 0.05 mg/kg. The Codex MRL for milks is 0.02 F mg/kg. The US MRL is for milk fat 0.1 mg/kg reflecting 0.02 mg/kg in whole milk. The Australian MRLs are *0.05 mg/kg for Brassica vegetables and 0.1 mg/kg for sweet corn and tomatoes.

The TF for deltamethrin in fat is roughly 0.03⁴⁰. Feeding of vegetables and their waste with residues of 0.1 mg/kg at 100% of the diet could result in deltamethrin residues in fat of $0.1 \times 0.03 = 0.003$ mg/kg, i.e. less than the Australian, Codex and USA tolerances. Anticipated residues in milk (TF 0.009) from feeding vegetables and their wastes are $0.1 \times 0.009 = 0.0009$ mg/kg.

Residues in sweet corn trash/forage are expected to be <0.5 ppm or 1 ppm when corrected for dry matter content. Feeding at 100% of the diet could result in deltamethrin residues in fat of $1 \times 0.03 = 0.03$ mg/kg. Anticipated residues in milk (TF 0.009) from feeding sweet corn trash/forage are $1 \times 0.009 = 0.009$ mg/kg.

³⁸ Chen-AW; Fink-JM; Letinski-DJ; Barrett-GP; Pearsall-JC (1997) Residue of cypermethrin and its major acid metabolites in milk and tissues from dairy bovines treated with cypermethrin. *J. Ag. Food Chem.* 45: 12, 4850-4855.

³⁹ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982 <http://www.fao.org/ag/AGP/AGPP/Pesticid/Default.htm>

⁴⁰ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Diazinon

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *vegetables* at an application rate of up to 1.12 kg ai/ha.

The harvest WHP is 14 days.

There are Australian, Codex and USA MRLs for diazinon in animal tissues. The MRLs for cattle fat are 0.7 mg/kg for Australia, 2 for Codex and 0.5 mg/kg for the US. For milk the MRLs are 0.5 [in the fat], 0.02 F mg/kg and not specified. The Australian MRL for vegetables is 0.7 mg/kg.

If assume the animal exposure is equal to the highest vegetable MRL (0.7 mg/kg) and use a TF for fat of 0.001⁴¹, estimated residues in fat are $0.7 \times 0.001 = 0.0007$ mg/kg. It is considered unlikely that diazinon would represent a problem for feeding of vegetables and their wastes).

Note the 1993 JMPR reported residues in sweet corn forage of *ca.* 5 ppm and a PF for tomatoes to pomace (dry) of 29. Feeding sweet corn forage at 100% of the diet could result in fat residues of $5 \times 0.001 = 0.005$ mg/kg. Feeding tomato pomace (dry) at 30% of the diet could result in fat residues of $0.3 \times 24 \times 0.7 \times 0.001 = 0.005$ mg/kg.

No residues were detected in milk of cows dosed at the equivalent of 120 ppm in the diet.

It is anticipated that animal product residues will be below typical method LOQs.

Dicamba

- is a selective herbicide used for the control of broadleaf weeds in crops and pastures. It is applied to *fallow crops*.

No harvest or grazing WHP is required.

There are no Codex MRLs for dicamba. The US (parent + metabolite) and Australian (parent) residue definitions differ. The relevant US MRLs for animal tissues are 0.25 mg/kg for meat, 25 mg/kg for kidney and liver and 0.2 mg/kg for milk. The Australian MRLs are meat (mammalian) at 0.05 mg/kg and milks at 0.1 mg/kg. Residues in soil and foliage decline with typical half-lives of 14 and 9 days respectively. The Australian use-pattern is such that residues in vegetables are not expected. There is no reasonable expectation of residues in animal commodities.

The APVMA Stockfeed data sheet⁴² summarised some residue data for dicamba:

Lactating dairy cattle were fed dicamba in the diet for 30 days at doses equivalent to 40, 120 and 400 ppm in the diet. Residues of dicamba and its DCSA metabolite in tissues of the high dose group were 0.89 mg/kg in kidney, 0.21 mg/kg in liver, 0.037 mg/kg in muscle and 0.059 mg/kg in fat. Maximum milk residues were 0.32 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

⁴¹ 1996 JMPR - Pesticide Residues in Food - 1996 Evaluations, Part I: Residues FAO Plant Production and Protection Paper 142. FAO and WHO 1997

⁴² <http://www.apvma.gov.au/residues/stockfeed.shtml>
Dicamba September 2004

Dichlofluanid

-is a fungicide used for the control of grey mould on *tomatoes*. The application rate is up to 1 kg ai/ha.

The harvest WHP is 1 day.

There are no Australian, Codex or US MRLs for dichlofluanid in animal tissues. The Australian MRL for tomatoes is 1 mg/kg.

JMPR data for tomatoes: residues ranged from 0.1 to 1 mg/kg following application up to 6 sprays at 1× at 0 to 7 DAT⁴³. No relevant animal metabolism data were reported in JMPR.

Insufficient data were located to provide confident opinion on livestock residue risks.

Dichlorvos

All vegetable use patterns are being removed from registered labels; no data to support uses.

Diclofop-methyl

-is an aryloxyphenoxypropionate herbicide used for control of annual grasses in *peas*. The application rate is 0.47 kg ai/ha with application made shortly after sowing.

No harvest WHP is required.

Do not graze or cut for stock feed for 7 weeks after application.

There are Australian but no Codex or US tolerances for diclofop-methyl in animal commodities. The Australian MRLs have all been set at *0.05 mg/kg. The Australian MRL for peas is 0.1 mg/kg.

The US EPA reported an animal feeding study for diclofop methyl and noted that animal MRLs would be required to be established. Four groups of lactating dairy cows were dosed orally *via* capsules for 28 consecutive days with diclofop-methyl at levels equivalent to 0.11, 0.33, 1.1, and 25.0 ppm in the diet⁴⁴. In tissues, residues were highest in kidney and lowest in muscle. For the 25 ppm feed level, the combined residues were 12-23 mg/kg in kidney, 3.9-6.1 mg/kg in liver, 0.75-0.85 mg/kg in fat, and 0.32-0.57 mg/kg in muscle. The TF for kidney and fat were 0.9 and 0.03 respectively.

Residues in whole milk plateaued by Day 4 at all dose levels. The maximum combined residues in whole milk were 0.023, 0.114, 0.212, and 2.759 ppm for the 0.11, 0.33, 1.1, and 25.0 ppm groups, respectively. Diclofop-methyl residues concentrated in milk fat, with residues in cream being 2.4-3.4× higher than in whole milk.

The data indicate a potential for residues of diclofop-methyl in animal commodities when the residue definition includes conjugates.

Results of residue trials on peas and beans reported by the UK PSD (Evaluation of fully approved or provisionally approved products. Issue No. 46. Evaluation on: diclofop-methyl, September 1991) indicate residues in foliage at 49 days after application are low, generally less than 0.05 mg/kg when applied at twice the Australian rate suggesting little potential for transfer of residues to livestock.

⁴³ 1979 JMPR - Pesticide Residues in Food - 1979 Evaluations, Part I Residues FAO Plant Production and Protection Paper 20 Suppl. FAO and WHO 1980

⁴⁴ Diclofop-Methyl Reregistration Eligibility Decision Residue Chemistry Considerations PC Code 110902; Case 2160 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Dicofol

- is an organochlorine miticide used for the control of various pests in a variety of crops. In *vegetables* it is used for the control of mites. The application rate is up to 55 g ai/hL.

The harvest WHP is 7 days.

Do not graze or cut for stock food.

There are no Australian or USA MRLs for animal commodities. The Australian and Codex residue definitions differ. The Australian residue definition is the sum of dicofol + 2,2,2-trichloro-1-(4-chlorophenyl)-1-(2-chlorophenyl)ethanol calculated as dicofol while the Codex residue definition for animal commodities is the sum of dicofol + 2,2-dichloro-1,1-bis(4-chlorophenyl)ethanol (p,p'-FW152) calculated as dicofol. There is a Codex MRL of 3 for cattle fat, 0.1 mg/kg for milk (F) and 1 mg/kg for cattle edible offal. The EU MRLs are 0.5 mg/kg for cattle and sheep meat, *0.05 mg/kg for cattle and sheep edible offal and 0.02 mg/kg for milk. There are Australian MRLs for vegetables [except cucumber, gherkin and tomato] of 5 mg/kg, tomato 1 mg/kg and cucumber and gherkin of 2 mg/kg.

Residues in soil and foliage decline with typical half-lives of 16- 60 days and >6 months respectively.

The TF for fat for the Australian and Codex residue definitions are 0.05-0.1 for Australia and 0.3-0.5 for the Codex residue definition⁴⁵.

(If assume 5 ppm in vegetables and waste and use a TF for fat of 0.3, estimated residues in fat are $5 \times 0.3 = 1.5$ mg/kg). A major deficiency in the available data is information on the decline of residues in cattle. In the absence of this information it is important that the likely residues in vegetables are better refined, perhaps through residue analyses or obtaining information on the actual use of dicofol (timing, rate, % crop treated) by the different industries.

Anticipated residues in milk (TFs 0.003-0.006 and 0.02-0.04 respectively.) are $5 \times 0.04 = 0.2$ mg/kg for the Codex and $5 \times 0.006 = 0.03$ for the Australian residue definition.

Livestock residues may exceed international and/or domestic market standards.

Dicofol can contain up to 1000 mg/kg DDT and related compounds⁴⁶, an application rate of 0.55 kg ai/ha (spray volume of 1000 L/ha) corresponds to a potential application of DDT at 0.55 g/ha. The TF for fat and milk fat are estimated to be 1.8 and 2.1 respectively. If residues DDT are present at the same ratio to dicofol as in the technical active ingredient the anticipated residues are $(5/1000) \times 1.8 = 0.009$ mg/kg in subcutaneous fat and $(5/1000) \times 2.1 = 0.01$ mg/kg in milk fat.

Difenoconazole

-is a triazole fungicide that is used in *potatoes* and *tomatoes* for target spot and in *carrots* for leaf blight. The application rate is 125 g ai/ha.

The harvest WHP is 3 days for tomatoes and 7 days for carrots and potatoes.

⁴⁵ Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

⁴⁶ Australian Pesticides And Veterinary Medicines Authority, Minimum Compositional Standards (MCS) for Active Constituents as of 30 January 2004, <http://www.apvma.gov.au/tgac/mincompstandards.pdf>

There are Australian, Codex and US MRLs for difenoconazole in animal tissues. The Australian MRLs have all been set at *0.05 mg/kg for tissues and *0.01 mg/kg for milk. The US MRL for cattle liver is 0.02, meat 0.05 and fat, meat byproducts (except liver) and milk is 0.1 mg/kg. Codex MRL for edible offal is 0.2, meat fat 0.05 and milk *0.005 mg/kg. The Australian MRLs are 0.2 mg/kg for carrot, *0.02 mg/kg for potato and 0.5 mg/kg for tomatoes.

Residues in tomatoes ranged from <0.02 to 0.22 mg/kg at 3 days after treatment at the Australian rate. No data were located for tomato waste.

Two metabolism studies were performed on lactating goats; a 10-day study with a dose rate equivalent to feeding at 4.2 ppm in the diet and a 3-day study with a dose rate equivalent to feeding at 100 ppm in the diet⁴⁷. The total radioactive residue (TRR) in the goat tissues was used to estimate the expected residues resulting from feeding vegetables waste with residues of 0.5 ppm at 100% of the diet. The maximum residue observed was in liver, estimated to be at a level of 0.02 ppm from both metabolism studies. This value is 2.5× below the LOQ of the proposed analytical enforcement method in the US (0.05 ppm).

It is anticipated that animal product residues will be below typical method LOQs.

Dimethenamid-P

- is a pre-emergent herbicide used for the control of weeds in *green beans, green peas, sweet corn and pumpkins*. It is registered on navy beans at application rates of up to 720 g ai/ha.

A harvest WHP is not required.

DO NOT graze or cut for stock food for 4 weeks after application.

There are Australian and Codex but no USA MRLs (negligible residue) for dimethenamid in animal tissues. The Australian and Codex MRLs for animal commodities have been set at *0.01 mg/kg. There is an Australian MRL of *0.02 mg/kg for various vegetables and for forage and fodder at *0.02 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Dimethoate

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *vegetables* at application rates of 30 g ai/hL (300 g ai/ha).

The harvest WHP is 7 days.

There are Australian, Codex and and USA MRLs for dimethoate in animal tissues. The Australian and Codex MRLs for animal commodities have been set at *0.05 mg/kg while the US ones are set at 0.02 mg/kg. There are Australian MRLs of 5 mg/kg for cucurbits and 2 mg/kg for other vegetables.

A metabolism study with lactating goats dosed orally with dimethoate suggests that residues are not expected in animal tissues⁴⁸.

⁴⁷ Difenoconazole Pesticide Tolerance Federal Register: September 15, 2000 (Volume 65, Number 180) Page 55911-55921

⁴⁸ 1998 JMPPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

It is anticipated that animal product residues will be below typical method LOQs.

Dimethomorph

- is a fungicide. It is used on *cucurbits, lettuce, onions* and *potatoes* at application rates of 180 g ai/ha.

The harvest WHPs are 7 days for cucurbits and onions, 14 days for lettuce and 7 weeks for potatoes.

There are Australian and Codex but no US MRLs for dimethomorph in animal commodities. The Australian and Codex MRLs have all been set at *0.01 mg/kg. The Australian vegetable MRLs are 0.5 mg/kg for cucurbits, 2 mg/kg for leafy vegetables (except head lettuce), 0.3 mg/kg for lettuce head, 0.05 mg/kg for onions and *0.02 mg/kg for potatoes.

The UK PSD reported a feeding study⁴⁹. Three groups of lactating dairy cows were administered dimethomorph (48/52 E/Z) orally, twice daily at feeding levels equivalent to 50, 150 or 500 mg/cow/day for 4-5 weeks. Residues of dimethomorph, VII (Z67), VIII (Z69) and XIII (CUR 7117) were all below 0.01, 0.02, 0.02 and 0.01 mg/kg respectively except for cow 14 from the highest dose group on day 45 of the study when residue levels were determined to be 0.03, 0.03 and 0.02 respectively for metabolites VII, VIII and XI.

It is anticipated that animal product residues will be below typical method LOQs.

Diquat

- is a herbicide used for the control of weeds in various crops. It is applied to *vegetables* at application rates of up to 0.8 kg ai/ha.

Harvest WHPs are 7 days for potatoes, 14 days for sweet potatoes and not required for other vegetables.

The Australian and Codex MRLs for diquat in meat (mammalian) are the same at *0.05 mg/kg. The US MRL for meat is 0.02 mg/kg. The MRLs for milk are *0.01 mg/kg, *0.01 mg/kg and 0.02 mg/kg respectively. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. No residues were detected in tissues of cows fed diquat for 28 days at 100 ppm in the diet and slaughtered on the last day of dosing (LOD 0.01 mg/kg)⁵⁰. Residues in vegetables and wastes would be expected to be less than 100 ppm. This suggests that no residues would be detected in animal tissues if fed vegetables, culls or processing waste.

It is anticipated that animal product residues will be below typical method LOQs.

Disulfoton

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *potatoes, peas* and *beans* for the control of aphids and two-spotted mites. The application rate is up to 14 kg ai/ha applied at planting.

Do not apply to edible crops later than 70 days before harvest

Do not graze or cut for stock food for 70 days after application

⁴⁹ Evaluation of fully approved or provisionally approved products. Issue 99: Evaluation on dimethomorph, April 1994, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

⁵⁰ Reregistration Eligibility Decision, Diquat Dibromide, List A, Case 0288, EPA 738-R-95-016 July 1995 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division. <http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

There are Australian but no USA or Codex MRLs for disulfoton in animal tissues. The Australian MRLs for animal commodities have been set at 0.02 mg/kg for meat and edible offal and at 0.01 mg/kg for milk. The Codex MRL for milk is 0.01 mg/kg. There are Australian MRLs of 0.5 mg/kg for vegetables.

The maximum residue in tissues of dairy cattle fed at 7.2 ppm in the diet was 0.03 mg/kg⁵¹. Scaling the maximum tissue residues for the vegetable MRL would give an anticipated residue in tissues of $(0.5 \div 7.2) \times 0.03$ mg/kg = 0.002 mg/kg which is below the limit of quantitation for the analytical technique. Feeding of vegetable culls and processing waste should not result in detectable residues of disulfoton in animal tissues.

It is anticipated that animal product residues will be below typical method LOQs.

Diuron

- is a herbicide used for the control of weeds in crop. It is applied pre-emergent as a directed spray to *asparagus* crops. The application rate is up to 1.8 kg ai/ha. No harvest or grazing WHP is required.

There are no Codex MRLs for diuron. The US and Australian residue definitions differ with the Australian definition including a metabolite in addition to the parent compound. The relevant US MRL for animal tissues is 1 mg/kg for cattle mbyop while the Australian MRL for edible offal of cattle is 3 mg/kg (the higher value probably reflecting the inclusion of the metabolite in the residue definition). The Australian MRL for milk is 0.1 mg/kg. The Australian MRL for asparagus is 2 mg/kg.

Residues in soil and foliage decline with typical half-lives of 90 and 30 days respectively. Australia has a primary animal feed commodity MRL of 50 mg/kg while the MRL for asparagus is 2 mg/kg.

NOTE: US MRLs have been established for animal feed items (including alfalfa forage and hay at 2 ppm and citrus pulp dry at 4 ppm) as well as for animal commodities. If the US MRLs are used to estimate the dietary burden using the US EPA Guideline, a dietary burden of ca. 4.8 ppm is estimated. An anticipated TF is the 1 ppm (animal commodity tolerances) \div 4.8 ppm (dietary burden) = 0.2 (crude estimate). Anticipated residues in tissues are $2 \times 0.2 = 0.4$ mg/kg. Note it is unlikely that significant quantities of asparagus would be fed to livestock.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Emamectin benzoate

- is a macrocyclic lactone insecticide used for the control of diamond back moth and cabbage white butterfly on *Brassica vegetables* and heliothis in *lettuce*, *capsicum* and *tomatoes*. The application rate is up to 13 g ai/ha for Brassica vegetables and 11 g ai/ha for lettuce, capsicum and tomato. The harvest WHP is 3 days.

Do not use treated crop, crop waste or produce for stock food

There are Australian and US but no Codex MRLs for emamectin benzoate in animal tissues. The Australian MRLs are 0.01 mg/kg for edible offal, *0.002 mg/kg for meat and *0.0005 mg/kg for milk. The US residue definition is the sum of emamectin (MAB1a + MAB1b isomers) and the

⁵¹ DISULFOTON Shaughnessy No. 032501; Case 0102 Reregistration Eligibility Decision: Product Chemistry Considerations 3 October 1997, Contract No. 68-D4-0010, Submitted to: U.S. Environmental Protection Agency by Dynamac Corporation

associated 8,9-Z isomers (8,9-ZB1a + 8,9-ZB1b). The USA MRL for cattle fat is 0.01 mg/kg, meat 0.003 mg/kg, meat by-products (except liver) 0.02 mg/kg, liver 0.05 mg/kg and milk 0.003 mg/kg. The Australian MRL for Brassica vegetables is 0.02 mg/kg, for lettuce 0.2 mg/kg and 0.01 mg/kg for capsicums and tomatoes.

A transfer factor of 0.3 for liver when fed at 0.1 ppm in the diet has been estimated⁵². Applying this TF to the MRL for Brassica vegetables fed at 100% of the diet gives a liver residue of 0.006 mg/kg (0.02×0.3). Anticipated residues in milk are (TF = 0.003) 0.02×0.003 = 0.00006 mg/kg. Residues would be 10× higher if feeding lettuce waste and account is taken of dry matter content of the feed.

Livestock residues may exceed international and/or domestic market standards.

Endosulfan

- is an organochlorine insecticide used for the control of various pests in a variety of crops. Application is to *beetroot, potatoes, carrot, sweet potatoes, broccoli, cabbage, cauliflower, cucurbits, tomatoes, eggplants, capsicum, okra, Cape gooseberry, celery* and *taro* at rates up to 0.755 kg ai/ha.

The harvest WHP is 3 days for cucurbits, capsicums and tomatoes; 7 days for eggplants, okra, celery, Cape gooseberry and Brassicas and 14 days for beetroot, potatoes, sweet potatoes, carrots and taro.

DO NOT feed treated melons or melon crops to livestock.

DO NOT feed vegetable wastes or wrapper leaves of treated vegetable crops to livestock.

DO NOT feed treated tomato crops to livestock.

For crops that do not have a feeding restriction the following ESI applies: Livestock that have been grazing on or fed treated crops should be placed on clean feed for 21 days prior to export slaughter.

There are Australian, Codex and USA MRLs for animal commodities. The Australian and Codex MRL for cattle fat is 0.2 mg/kg while the US MRL is 13 mg/kg. The Australian MRL for milk [in the fat] is 0.2 mg/kg, USA 2 mg/kg for milk fat and Codex 0.1 F mg/kg. There is an Australian MRL for oilseed set at 1 mg/kg and a primary animal feed commodity MRL of 0.3 mg/kg.

Residues in soil and foliage decline with typical half-lives of 50 and 3 days respectively although the decline of residues in senescent foliage is much slower.

The TF for fat is 0.3-0.4⁵³. The TF for milk is 0.02. The use pattern for Brassica vegetables (excluding Brussels sprouts) is application at 67 g ai/hL, WHP 7 days. Maximum residues were 0.29 ppm (FW). Feeding at 100% diet, assuming 30% DM would give residues of 0.29/0.3×0.4 = 0.39 mg/kg in fat.

The use pattern for cucurbits is application at 67 g ai/hL, WHP 7 days. Maximum residues were 0.23 ppm (FW). Feeding at 100% diet, assuming 30% DM would give residues of 0.23/0.3×0.4 = 0.31 mg/kg in fat.

Residues should be less than international standards following 21 days on “clean feed”, the ESI.

Noting the conservative nature of the calculations, livestock residues are not anticipated to exceed international and/or domestic market standards.

⁵² APVMA Animal Residue Data Sheet – Emamectin, October 2002

⁵³ Reregistration Eligibility Decision for Endosulfan Case No. 0014 EPA 738-R-02-013 November 2002
Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division.
<http://cfpub.epa.gov/oppref/rereg/status.cfm?show=rereg>

EPTC (eptam)

-is a thiocarbamate herbicide used for the pre-emergent control of certain grasses and broad-leaved weeds and is used as a pre-plant application in crops. It is used on *beans, potatoes* and *sweet corn* at 3.96 kg ai/ha.

No harvest WHP required.

There are Australian but no Codex or US tolerances for EPTC in animal commodities. The Australian MRLs are set at *0.1 mg/kg. The Australian MRLs for vegetables is *0.04 mg/kg. As no residues are present in the crops at harvest there is no reasonable expectation of residues in animal commodities.

It is anticipated that animal product residues will be below typical method LOQs.

Esfenvalerate

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on Brassica vegetables (broccoli, cabbage etc), broad beans, celery, garden peas, green beans, sweet corn and tomatoes.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Brassica vegetables</i>	19	2	-
<i>Broad beans</i>	16.5	14	7
<i>Celery</i>	2.5 g ai/hL	1	-
<i>Garden peas</i>	25	14	7
<i>Green beans</i>	16.5	3	7
<i>Sweet corn</i>	25	7	7
<i>Tomatoes</i>	20	2	-

Esfenvalerate residues decline with typical half-lives of 35 and 8 days for soil and foliage respectively.

There are Australian, Codex and USA MRLs for fenvalerate or esfenvalerate in animal tissues. The relevant MRLs for cattle fat are 1 (meat mammalian [in the fat]), 1 and 1.5 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for milk are 0.2 mg/kg, 0.1 F mg/kg and 0.3 mg/kg (7 mg/kg for milk fat) for Australia, Codex and the USA respectively. There are Australian MRLs of 1 mg/kg for Brassica vegetables, 2 mg/kg for celery, 0.5 mg/kg for legume vegetables, 0.05 mg/kg for sweet corn (corn-on-the-cob) and 0.2 mg/kg for tomatoes. There is also a PAFC MRL of 10 ppm.

An estimate of likely residues in garden pea and green and broad bean forage/fodder can be made by utilising information for other legume forages (field peas, soy beans etc). Residues in forages of legumes when scaled for application rate were all less than 5 ppm.

In an Australian trial reported by the 1990 JMPR, residues of fenvalerate were measured in cabbages following 9 sprays at 118 g ai/ha (6× the Australian label rate for esfenvalerate). Residues in hearts were 0.21, 0.05 and 0.09 mg/kg at 3, 5 and 10 days after the last spray. Residues in discard leaves, those leaves that are usually trimmed in the field and ploughed in, were 10.8, 7.5 and 4.9 mg/kg at 2, 3 and 5 days after the last spray. Residues of (es)fenvalerate are expected to be less than 5 ppm in waste from Brassica vegetables.

In a trial reported by the 1984 JMPR residues in sweet corn foliage were 0.3 mg/kg at 3 days after a single application of fenvalerate at 50 g ai/ha. Although the data are only from a single trial, the data suggest only low levels of (es)fenvalerate residue are expected in sweet corn trash.

Residues in vegetable culls and processing waste are not expected to exceed 5 ppm, the maximum level that fenvalerate should be fed at in the diet for animals to still comply with the Australian MRL. Residues of esfenvalerate from feeding vegetable waste are unlikely to present a trade risk.

The dairy cow feeding study with [¹⁴C]fenvalerate was designed to provide residue transfer information as well as metabolism information⁵⁴. The level of fenvalerate in the animal diet was 79 ppm. Approximate levels of ¹⁴C and % as fenvalerate were: fat 1-3 mg/kg (90%+), milk 0.47 mg/kg (90%+), muscle 0.25 mg/kg (90%), liver 2 mg/kg (<1%) and kidney 1.4 mg/kg (17%).

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Ethephon

- is a plant growth regulator. It is applied close to harvest on *tomatoes* to accelerate ripening and increase marketable fruit size. The application rate is up to 0.86 kg ai/ha.

A harvest WHP of 7 days applies.

The Codex and Australian MRLs for ethephon in edible offal are the same at 0.2 mg/kg. The Codex and Australian milk MRLs are *0.05 and 0.1 mg/kg. The US tolerance for offal is 0.2 mg/kg for milk is 0.01 mg/kg. Residues in soil and foliage decline with typical half-lives of 10 and 5 days respectively. Australia has a primary animal feed commodity MRL of 10 mg/kg. The MRL for tomatoes is 2 mg/kg.

The 1990 JMPR reported data for the concentration of residues on processing of tomatoes with residues in dry pomace concentrating by a factor of 1.9. Applying this factor to the Australian tomato MRL gives a maximum anticipated residue in tomato pomace (dry) of 3.8 ppm, well below the Australian primary animal feed commodity MRL of 10 ppm. Feeding at 3.8 ppm is unlikely to result in residues in animal tissues that exceed the US MRLs.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Ethofumesate

- is a benzofuran herbicide used for the control of certain weeds in *beet crops* and *onions*. It is applied at the pre-emergent or early post-emergent crop stage. The application rate is up to 3 kg ai/ha (pre-emergent on beet crops) or 0.6-1 kg ai/ha if used early post-emergence.

The harvest WHP is 13 weeks for onions and not required for beet crops

There are Australian and US but no Codex MRLs for ethofumesate in animal commodities. The Australian MRLs are 0.5 mg/kg for edible offal and meat (mammalian) (fat) with parent compound as the residue definition. The MRL for milks [in the fat] is 0.2 mg/kg. The US MRLs are all 0.05 mg/kg (the sum of ethofumesate and its metabolites 2-hydroxy-2,3-dihydro-3,3-dimethyl-5-benzofuranyl methanesulfonate and 2,3-dihydro-3,3-dimethyl-2-oxo-5-benzofuranyl methanesulfonate, both calculated as the parent compound). No MRL for milk has been set.

⁵⁴ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

There are Australian MRLs for beetroot (0.1 mg/kg), silver beet (1 mg/kg) and onions (bulb vegetables) (*0.1 mg/kg).

The US EPA reported⁵⁵ a feeding study in which three groups of dairy cows were dosed orally via capsules with ethofumesate at the equivalent of 2.2, 6.6, and 22 ppm of ethofumesate in the diet. Milk and tissue samples were analyzed using a GC/FPD-S method (Method B-93R-04/05) that specifically determined residues of ethofumesate and its metabolites NC 8493 and NC 9607. Using the above GC/FPD-S method, residues of ethofumesate, NC 8493, or NC 9607 were each <0.01 ppm in all milk samples taken from the highest dose group, whole milk samples taken from the two low dose groups on days 21, 24 and 28, and in cream and skim milk sample from Day 28 for all 3 dose groups. For tissues, residues of ethofumesate, NC 8493, or NC 9607 were also <0.01 ppm in all tissues samples from each dose group, with the exception of one fat sample from the highest dose group bearing residues of ethofumesate at 0.02 ppm.

It is anticipated that animal product residues will be below typical method LOQs.

Fenamiphos

- is an organophosphate insecticide used for the control of various insects and nematodes. It is registered on *Brassica vegetables, carrots, parsnips, potatoes and tomatoes* for use from seeding (within 7 days) or transplanting. The application rate is up to 9-11 kg ai/ha. The harvest WHP for carrots and potatoes is 12 weeks.

There is no US MRL for fenamiphos in animal tissues. The relevant Australian and Codex MRLs for fenamiphos in animal tissues are *0.05 and *0.01 mg/kg, respectively, and MRL for milk is *0.005 mg/kg for both Australia and Codex. The primary animal feed commodity MRL for fenamiphos is 1 mg/kg. Australian use-pattern is such residues are not expected in Brassica vegetables at harvest (MRLs *0.05 mg/kg).

The MRLs for potatoes, parsnip and carrots are 0.2 mg/kg while that for tomatoes is 0.5 mg/kg. The 1999 JMPR reported a PF of 2.5 for tomatoes to pomace (dry), applying this to the Australian MRL for tomatoes gives an estimated maximum residue in tomato pomace (dry) of 1.25 ppm. In a dairy cattle feeding study, residues in tissues of cattle fed at the equivalent of 20 ppm in the diet were ≤0.01 mg/kg⁵⁶.

It is anticipated that animal product residues will be below typical method LOQs.

Fenarimol

- is a fungicide used for the control of powdery mildew on *cucurbits*. The application rate is up to 24 g ai/ha.

The harvest WHP is 3 days

There are Codex and US but no Australian MRLs for fenarimol in animal tissues. The Codex MRLs are 0.05 mg/kg for cattle liver and *0.02 mg/kg for cattle kidney and meat. The relevant USA MRLs for fenarimol in animal tissues are 0.01 for cattle fat, meat and kidney and 0.05 mg/kg for meat and meat by-products (other offals). The Australian MRL for cucurbits is 0.2 mg/kg.

⁵⁵ MEMORANDUM, Date: 9/21/04, Subject: Ethofumesate. Residue Chemistry Considerations for Reregistration Eligibility Decision. Case No. 2265. DP Barcode: D288646 PC Code: 110601 40 CFR.: §180.345 From: José J. Morales To: Nancy McCarroll

⁵⁶ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

In a goat metabolism study where goats were dosed with ¹⁴C-fenarimol at the equivalent of 10 ppm in the diet for 5 days, no residues of fenarimol (parent compound) were detected in liver and kidney⁵⁷. Radioactive residues in fat and muscle were 0.01-0.03 mg equiv/kg. Anticipated residues in fat from feeding of culls and waste derived from cucurbits treated with fenarimol at 100% of the diet and assuming the same residue the Australian MRL are $0.2 \times 0.003 = 0.0006$ mg/kg. The anticipated residue is less than likely regulatory method LOQs.

It is anticipated that animal product residues will be below typical method LOQs.

Fenitrothion

-is an OP insecticide used to control Australian plague locust in *cabbages, lettuce and tomatoes*. The application rate is up to 400 g ai/ha. No harvest WHP required.

There are Australian and Codex but no US MRLs for fenitrothion in animal tissues. The relevant Australian and Codex MRLs for cattle fat are T*0.05 and *0.05 mg/kg respectively. The Australian MRL for milks is T*0.05 [in the fat] mg/kg and the Codex MRL is *0.1 mg/kg. The Australian MRL for vegetables is 0.5 mg/kg.

Residues in tissues were <0.05 mg/kg in a 28 day lactating cow feeding study conducted at a feeding level equivalent to 100 ppm in the feed⁵⁸.

It is anticipated that animal product residues will be below typical method LOQs.

Fenthion

- is an organophosphate insecticide used for the control of various pests. It is registered on *tomatoes, peppers, eggplant and cucurbits* for the control of fruit fly (pre- and post harvest). The pre-harvest application rate is up to 0.41 kg ai/ha for tomatoes, peppers and egg plants while the post-harvest application is by dipping (or flood spraying) with a 4 ppm solution (fruiting vegetables). The harvest WHP is 7 days.

There are Australian and US (expired on 1/4/06) but no Codex MRLs for fenthion in animal tissues. The relevant Australian and USA MRLs for fenthion in animal tissues are 1 mg/kg in Australia and 0.1 mg/kg in the US. The relevant milk MRLs are T0.2 and 0.01 mg/kg respectively. The Australian MRL for cucurbits is 3 mg/kg and for other fruiting vegetables (tomatoes, eggplants, peppers etc) 5 mg/kg.

Residues in tissues of lactating dairy cows fed at a nominal feed level of 7.6 ppm were all <0.05 mg/kg⁵⁹. The TF for milk is 0.002.

It is anticipated that animal product residues will be below typical method LOQs.

⁵⁷ 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

⁵⁸ The NRA Review of Fenitrothion Interim Report Volume 2, June 1999, Existing Chemicals Review Program National Registration Authority for Agricultural and Veterinary Chemicals – Residues Assessment

⁵⁹ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

Fipronil

- is a phenylpyrazole insecticide. Application to *Brassica vegetables* (broccoli, cabbage etc) is for control of diamond back moth, cabbage white butterfly and cabbage cluster caterpillar and is at an application rate of 50 g ai/ha. Application to *potatoes* for control of wireworm, mole cricket and white fringed weevil is at planting at a rate of 100 g ai/ha.

The harvest WHP is 7 days for Brassica vegetables and not required for potatoes.

Potatoes: Do not graze or cut for stock food any part of failed crop (including tubers).

The relevant Australian, Codex and US tolerances for fipronil in animal fat are 0.1, 0.5 (cattle meat in the fat) and 0.4 mg/kg respectively while the milk MRLs are 0.01, 0.02 mg/kg while the US MRL is 1.5 mg/kg for milk fat (representing 0.05 mg/kg in whole milk). The Australian MRL for Brassica vegetables is 0.05 mg/kg while that for potatoes is *0.01 mg/kg. Foliar residues of fipronil are reported to decline with a typical half-life of 2-4 days.

If maximum residues in vegetable waste are assumed to be at the Brassica vegetable MRL (0.05 mg/kg) and using the transfer factor for fat reported by the 2001 JMPR (TF = 1.1-1.2)⁶⁰, anticipated maximum residues in cattle fat are $\approx 0.05 \times 1.2 = 0.06$ mg/kg. The TF for milk is 0.1 giving anticipated residues in milk of $\approx 0.05 \times 0.1 = 0.005$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Fluazifop-p

- is a selective post-emergent herbicide used for the control of certain grasses in crops such as canola, cotton, sunflower, legumes and pastures.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Broad beans</i>	0.212	5	5
<i>Green beans</i>	0.212	5	5
<i>Brassica vegetables</i>	0.212	6	-
<i>Capsicums</i>	0.212	11	-
<i>Tomatoes</i>	0.212	4	-
<i>Lettuce</i>	0.212	4	-
<i>Celery</i>	0.212	8	-
<i>Carrots</i>	0.212	7 weeks	7 weeks
<i>Peas</i>	0.159	7 weeks	7 weeks
<i>Potatoes</i>	0.424	10 weeks	-
<i>Cucurbits</i>	0.212	21	-

There are Australian and USA but no Codex animal tissue MRLs for fluazifop. The relevant Australian MRLs are *0.05 for edible offal and meat and 0.1 for milk. The US tolerances for animal commodities have all been set at 0.05 mg/kg (fluazifop-butyl). The relevant Australian vegetable MRLs are Brassica vegetables (1 mg/kg), carrots, cucurbits, legume vegetables and tomatoes 0.1 mg/kg, celery *0.02 mg/kg, lettuce and potato 0.05 mg/kg and peppers *0.02 mg/kg.

⁶⁰ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

The relevant TFs for fluazifop are 0.01 for kidney and milk and 0.005 for fat (12 ppm feeding level)⁶¹. Feeding vegetable culls and processing wastes with residues at the Australian MRLs is unlikely to lead to residues in animal tissues above typical regulatory LOQs (assumed 0.01 mg/kg).

It is anticipated that animal product residues will be below typical method LOQs.

Fluazinam

-is a fungicide used for the control of club rot in *brassica vegetables*. Application is made to seedlings at planting. The Australian MRL for Brassica vegetables is *0.01 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Flubendiamide

- is an insecticide. It is used for the control of various lepidopteran pests in vegetables.

Crop	Rate	WHP
Brassica vegetables (including broccoli, Brussels sprouts, cabbage, cauliflower, kohlrabi)	48 g ai/ha	3 days
Capsicum	72 g ai/ha	1
Lettuce	48 g ai/ha	1
Tomato	72 g ai/ha	1

Do not use on brassicas grown for forage or fodder. Do not graze treated brassica crops.

There are Australian and US but no Codex MRLs for animal commodities. The Australian MRLs are 0.03 mg/kg for edible offal, 0.05 mg/kg for meat (fat), *0.01 mg/kg for milks and 0.05 mg/kg for milk fat. The US MRLs are 0.3 mg/kg for fat, kidney, liver, 0.05 mg/kg for muscle, 0.04 mg/kg for milk and 0.3 mg/kg for milk fat. The Australian vegetable MRLs are: brassica (cole or cabbage) vegetables, head cabbages, flowerhead brassicas 5 mg/kg, tomatoes 2 mg/kg and capsicums 1 mg/kg. There is an Australian MRL for tomato pomace (dry) of 20 ppm.

Note the STMR for flubendiamide in tomato is 0.15 mg/kg and using a processing value of 4.5, residues in tomato pomace (dry) should not exceed 0.675 ppm.

An animal transfer study was provided with the original Category 1 application for flubendiamide. Lactating cattle were dosed with flubendiamide at the equivalent of 2.9, 8.5, 38 or 60 ppm in the feed for 29 days. On day 29, the animals were sacrificed and liver, kidney, composite muscle, subcutaneous fat, omental fat and perirenal fat were collected for analysis. Two additional lactating cattle from the 69 ppm group were sacrificed on study days 38 and 52 respectively to examine residue depuration. Samples of liver, kidney, composite muscle, subcutaneous fat, omental fat and perirenal fat were collected for analysis. Highest observed residues in tissues and milk at a feeding level of 2.9 ppm are summarised below.

Sample	Total flubendiamide residue (mg/kg) after dosing at 2.9 ppm
Liver	0.06
Kidney	0.06
Muscle	0.01
Fat (perirenal)	0.11
Milk	0.02

⁶¹ UK PSD Evaluation of fully approved or provisionally approved products. Issue No. 10 Evaluation on: Fluazifop-P-butyl, October 1988

Residues in fat after feeding Brassica vegetables at 100% diet are expected to exceed 0.2 mg/kg. The maximum level that can be incorporated in the diet and leave residues <0.01 mg/kg is 0.26 ppm (dry weigh basis).

Livestock residues may exceed international and/or domestic market standards.

Fludioxinil

-is a fungicide used for the control of seed borne silver and black scurf in *potatoes*. It is applied as a seed treatment at an application rate of 2.5 g ai/tonne of seed potatoes.

A harvest WHP is not required.

There are Australian but no Codex or US MRLs for animal tissues. The Australian MRLs have been set at *0.05 for edible offal and *0.01 mg/kg for meat and milk. The Australian MRL for potatoes is 0.02 mg/kg.

No residues were observed above the analytical LOQ of 0.01 mg/kg (meat) and 0.05 mg/kg (liver and kidney) in an animal transfer study conducted in dairy cattle. Lactating cows were treated with fludioxinil in gelatine capsules equivalent to 0.55, 1.6 and 5.5 ppm in feed for 28-30 consecutive days⁶². Overseas data show that potato peelings (dry) contained residues of up to 0.07 mg/kg from potato tubers with residues of <0.01 mg/kg after treatment according to the Australian use pattern.

It is anticipated that animal product residues will be below typical method LOQs.

Flumetsulam

Flumetsulam is registered (APVMA permits) for use on lettuce and chicory. However, for lettuce, the situation is considered non-food, as the target crop is grown for seed production. For chicory, it is a condition of the permit that treated produce is not made available for human or animal consumption.

It is anticipated that animal product residues will be below typical method LOQs.

Fluroxypyr

- is a selective herbicide used for the control of broadleaf weeds in crops such as sugarcane, maize, sorghum and winter cereals as well as pastures. It is applied post-emergent to *sweet corn* up to the tasselling growth stage. The application rate is up to 0.3 kg ai/ha.

No harvest WHP is required. Do not graze failed crops and cut for stock feed for 7 days after application.

There are no Codex animal tissue MRLs for fluroxypyr. The US (parent + metabolite) residue definition differs to that used in Australia (parent). The relevant US MRL for animal tissue is 1.5 mg/kg for cattle kidney and 0.3 mg/kg for milk. The relevant Australian MRL is 0.1 mg/kg for edible offal (mammalian except kidney), mammalian kidney *0.01 and 0.1 mg/kg for milk. The Australian MRLs for forage, straw and fodder (dry) and hay of cereal grains and other grass like plants are 100 mg/kg.

In animals, fluroxypyr residues decline rapidly upon cessation of dosing at 1000 ppm for 28 days such that after 6 days residues in all tissues are less than the limit of analytical quantitation.

⁶² Public Release Summary on Evaluation of the new active Fludioxinil in the product Maxim 100 FS Fungicide Seed Treatment National Registration Authority for Agricultural and Veterinary Chemicals April 2000 Canberra Australia

Insufficient data were located to provide confident opinion on livestock residue risks.

Flutolanil

-is an anilide fungicide used for the control of black scurf in seed *potatoes*. Application is at 70 g ai/tonne seed potatoes.

No harvest WHP is required.

There are Australian and US but no Codex MRLs for flutolanil in animal commodities. The Australian and US residue definitions are the same. The Australian MRLs are *0.05 mg/kg for edible offal, meat [in the fat] and milk. The US MRLs for cattle commodities are 2 mg/kg for liver, 1 mg/kg for kidney, 0.1 mg/kg for fat, 0.05 mg/kg for meat and meat bypr (other than liver and kidney) and 0.05 mg/kg for milk.

The Australian MRL for potatoes is 0.05 mg/kg. The US EPA reported that “*concentration of residues was observed into wet peel (1.7×)*”.

In an animal transfer study in cows in which cows were dosed at a level equivalent to feeding at 44 ppm in the diet, residues in fat and offal (kidney and liver) were up to 0.05, and 2.03 mg/kg respectively while residues in milk were <0.05 mg/kg⁶³. Residues in meat [in the fat] and offal would be undetectable as a result of feeding potatoes and potato processing waste.

It is anticipated that animal product residues will be below typical method LOQs.

Fluvalinate

see tau-fluvalinate

Glufosinate ammonium

-is a non-selective foliar herbicide used for the control of broadleaf weeds and grasses in crops such as cotton, maize, sorghum and winter cereals as well as pastures. It is applied as an inter-row spray to *tomatoes*. The application rate is up to 1 kg ai/ha.

No harvest WHP required

The Australian MRLs are 5 mg/kg for offal, 0.1 mg/kg for meat and *0.05 mg/kg for milk. The Codex MRLs are *0.1 mg/kg for edible offal, *0.05 mg/kg for meat and *0.02 mg/kg for milks. The relevant USA MRL is 6 mg/kg for cattle mbypr while the MRLs for meat and fat are 0.15 and 0.4 mg/kg respectively. The US MRL for milk is 0.15 mg/kg. There is an MRL for mixed pasture of 15 mg/kg while the tomato MRL is *0.05 mg/kg.

The JMPR have reported that residues were <0.01 mg/kg in edible offal and meat of cattle fed at the equivalent of 27 ppm in the diet⁶⁴.

It is anticipated that animal product residues will be below typical method LOQs.

Glyphosate

⁶³ Public Release Summary on Evaluation of the new active FLUTOLANIL in the product MONCUT SC FUNGICIDE National Registration Authority for Agricultural and Veterinary Chemicals January 2002 Canberra Australia

⁶⁴ Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

-is a non-selective foliar herbicide used for the control of broadleaf weeds and grasses in crops such as cotton, maize, sorghum and winter cereals as well as pastures. It is used to control weeds in agricultural land (*vegetables*) prior to sowing at an application rate of 3.2 kg ai/ha. It is applied as a post-plant, pre-emergent spray on *onions*. The application rate is up to 0.47 kg ai/ha. No harvest or grazing WHPs are required.

The relevant Australian and Codex MRLs are the same at 2 mg/kg for cattle offal. MRL for milk is *0.1 and *0.05 mg/kg for milk. The relevant USA MRL is 5 mg/kg for cattle meat byproducts. The primary animal feed commodity MRL for glyphosate is 150 mg/kg, the onion, cucurbits, fruiting vegetables other than cucurbits, leafy vegetable and legume vegetables MRL is *0.1 mg/kg.

Residues in cattle, pig and poultry meat, eggs and milk were determined after the animals were fed with a diet containing 100 mg/kg glyphosate and aminoglyphosate acid⁶⁵. The highest residues were in pig liver and kidney (up to 0.16 and 0.91 mg/kg, respectively) and cattle kidney (up to 1.4 mg/kg).

It is anticipated that animal product residues will be below typical method LOQs.

Guazatine

- is a systemic fungicide used for the post-harvest control of grey moulds and various rots in *tomatoes*. It is registered on tomatoes as a post-harvest dip at 100 g ai/100L (1 ppm). There is a permit use for post-harvest dip of rockmelons at 52 ppm.

There are no Australian, USA and Codex MRLs for guazatine in animal tissues. There is an Australian MRL for tomatoes at 5 mg/kg. The MRL for melons is 10 mg/kg.

The levels of guazatine residues in tomatoes that have been treated at 1× the post-harvest dip rate range from 1.6 to 1.85 mg/kg. No information was located on the levels of guazatine residues in tomato pomace, however, considering it is a post-harvest application it is unlikely that processing tomatoes would be treated.

Negligible residues were observed in fat and muscle (<0.02 mg equiv./kg) of cows dosed with ¹⁴C-guazatine at the equivalent of 12.5 ppm in the diet⁶⁶.

It is anticipated that animal product residues will be below typical method LOQs.

Haloxfop-R

- is a selective post-emergent herbicide used for the control of certain grasses in crops such as grain legumes, oilseeds and legume pastures. The application rate for *onions* (APVMA permit) is up to 104 g ai/ha.

The harvest WHP is 10 weeks

⁶⁵ FAO/WHO (1986a) Pesticide residues in food - Evaluations 1986. Part I - Residues. Joint Meeting of the FAO Panel of Experts Residues in Food and the Environment and the WHO Expert Group on Pesticide Residues, Rome, 29 September-8 October 1986. Rome, Food and Agriculture Organization of the United Nations (FAO Plant Production and Protection Paper 78/1).

⁶⁶ 1997 JMPR Pesticide Residues in Food - 1997 evaluations, FAO Plant Production and Protection Paper 146. FAO and WHO 1998

There are Australian but no USA or Codex animal tissue MRLs for haloxyfop. The relevant Australian MRLs are 0.5 mg/kg for edible offal, 0.02 mg/kg for meat (fat) and 0.02 mg/kg for milk. The Australian MRL relevant to onions is T*0.05 mg/kg.

The TF for cattle fat is 0.05 and cattle kidney 0.19⁶⁷. If it is assumed residues are present at the same level as the MRL residues in cattle tissues would be $0.05 \times 0.05 = 0.0025$ mg/kg in fat and $0.05 \times 0.19 = 0.0095$ mg/kg in kidney if onions are included at 100% of the diet.

The TFs for milk and cream are 0.016 and 0.15. If it is assumed residues are present at the same level as the MRL, residues in milk and cream would be $0.05 \times 0.016 = 0.0008$ mg/kg in milk and $0.05 \times 0.15 = 0.0075$ mg/kg in cream.

It is anticipated that animal product residues will be below typical method LOQs.

Imazalil

- is a systemic fungicide used for the post-harvest control of storage diseases in *potatoes*. It is registered on potatoes as a post-harvest mist at *ca.* 15 g ai/tonne of potatoes.

A WHP is not required when used as directed.

Do not feed treated produce or by-products to food producing animals, including poultry

There are USA but no Australian and Codex MRLs for imazalil in cattle tissues. The US MRL for cattle meat byproducts is 0.2 mg/kg while the other MRLs for cattle tissues and milk are set at 0.01 mg/kg. The US MRL for milk is 0.02 mg/kg. There is an Australian MRL for potatoes at 5 mg/kg and melons except water melons of 10 mg/kg.

The 1984 JMPR reported⁶⁸ that residues in potato peel were approximately 4× that of whole potatoes. Residues in potato processing waste are not expected to exceed 4×5 mg/kg = 20 ppm.

Residues of imazalil in tissues (parent compound) following dosing at a rate equivalent to a feed level of 33 ppm were 0.00-0.014 mg/kg in fat and muscle and 0.14-0.51 mg/kg in liver⁶⁹. Residues in milk were 0.005-0.017 mg/kg (parent compound).

Livestock residues may exceed international and/or domestic market standards.

Imidacloprid

- is a chloronicotinyl (pyridylmethylamine) insecticide. Application to vegetables is for control of aphids, silver-leaf whitefly and thrips and is at an application rate of 50-60 g ai/ha.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Cucurbits</i>	60	1	-
<i>Capsicums, egg plants, potatoes</i>	60	3	-
<i>Lettuce</i>	5 g ai/100 m row	-	-

⁶⁷ Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

⁶⁸ 1984 JMPR Pesticide Residues in Food - 1984 Evaluations FAO Plant Production and Protection Paper 67. FAO and WHO 1985

⁶⁹ Reregistration Eligibility Decision Residue Chemistry Considerations PC Code No. 111901; Case 2325 Imazalil. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

Crop	Rate (g ai/ha)	Harvest WHP (days)	Grazing WHP (days)
Tomatoes	60	7	-
Sweet potatoes	50	7	-
Brassica vegetables	60	7	-
Common beans	5 g ai/100 m row	-	42

There are Australian, Codex and US MRLs for imidacloprid in animal tissues. The relevant Australian and US tolerances for imidacloprid in edible offal are 0.2 and 0.3 mg/kg respectively and for milk 0.05 and 0.1 mg/kg. The Codex MRLs are 0.05 mg/kg for edible offal and *0.02 mg/kg for both meat mammalian and milk. The Australian MRLs for vegetables are: Brassica vegetables 0.5 mg/kg, cucurbits 0.2, fruiting vegetables except sweet corn (tomatoes, egg plant, capsicums etc) 0.5 mg/kg, potato 0.3 mg/kg, sweet corn (corn-on-the-cob) *0.02 mg/kg, and sweet potato 0.3 mg/kg. The MRL for lettuce is 5 mg/kg and for common beans T1 mg/kg. There are animal feed MRLs of 10 ppm for sweet corn forage, bean forage and fodder of T10 ppm, and Brassica forage crops (kale, rape, turnip, swede) of 1 ppm.

The 2002 JMPR reported processing factors of 4.3 for tomatoes to pomace (dry) and 2.9 for potatoes to potato peel (dry). Highest residues are expected to arise from feeding of sweet corn and bean forage/fodder with maximum residues of 10 ppm. The TF for liver is 0.01⁷⁰.

Assuming residues in vegetable waste at 10 ppm and feeding at 100% of the diet, residues in liver would be $10 \times 0.01 = 0.1$ mg/kg. The TF for milk is 0.003. Anticipated maximum residues in milk are $10 \times 0.003 = 0.03$ mg/kg.

The $t_{1/2}$ in forage/fodder is about 7 to 10 days.

Noting the conservative nature of the assumptions, livestock residues are not anticipated to exceed international and/or domestic market standards.

Indoxacarb

- is a oxadiazine insecticide. Application to *Brassica vegetables, tomatoes, capsicum, egg plant and lettuce* is for control of heliothis and is at an application rate of 68-100 g ai/ha.

The harvest WHP is 3 days for lettuce, peppers, eggplant and tomatoes and 7 days for the other vegetable crops.

Do not allow livestock to graze crops or waste that may have been treated

There are Australian, Codex and US MRLs for indoxacarb in animal tissues. The relevant Australian, Codex and US tolerances for indoxacarb in cattle fat are 1, 1 and 1.5 mg/kg respectively and for milk 0.05, 2 F and 0.15 (4 mg/kg for milkfat) mg/kg. The Australian MRLs for Brassica vegetables, lettuce and tomatoes are 2, 3 and 0.2 mg/kg respectively. The MRLs for peppers and egg plants are both 0.5 mg/kg. There is an Australian MRL for tomato pomace (dry) of 10 ppm.

The TF for fat is 0.03⁷¹. Assuming that the residues in vegetable waste do not exceed the MRL of 10 ppm for tomato pomace, residues in cattle fat would be expected to be $0.3 \times 10 \times 0.03 = 0.09$

⁷⁰ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

⁷¹ Indoxacarb; Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food, Federal Register: March 17, 2004 (Volume 69, Number 52) Page 12664-12670

mg/kg if fed at 30% of the diet, less than the Australian and USA MRLs. Residues will also be mitigated by the short residue depletion half-life for cattle tissues, estimated to be <4 days.

The TF for milk is 0.002. Anticipated residues in milk of animals fed tomato pomace at 30% of the diet are $0.3 \times 10 \times 0.002 = 0.006$ mg/kg.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Ioxynil

- are selective herbicides used for the control of broad-leaved weeds in *onions*. Ioxynil is applied when the crop is between the three and eight leaf stage of growth. The application rate is up to 0.7 kg ai/ha.

No harvest or grazing WHP is required.

There are no Australian, Codex or US animal tissue MRLs for ioxynil. Detectable residues are not expected in onions at the time of harvest; the Australian MRLs for ioxynil in onions is *0.02 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Iprodione

- is a systemic fungicide used for the control of moulds in vegetables. It is registered on *celery*, *lettuce*, *potatoes* and *tomatoes* at an application rate of 500 g ai/ha.

The harvest WHP is 1 day for celery and lettuce and 7 days for tomatoes and not required for potatoes.

There are Australian and US MRLs but no Codex MRLs for iprodione in animal tissues. The Australian MRLs have all been set at *0.1 mg/kg. The US MRLs are 3 mg/kg for cattle liver and kidney and 0.5 mg/kg for cattle fat, meat and meat by-products (except liver and kidney) and milk. The US residue definition is the sum of iprodione + isomer (RP-30228) + metabolite (RP-32490) + metabolite (RP-36114). There are Australian MRLs for celery (2 mg/kg), lettuce (5 mg/kg), potato (*0.05 mg/kg) and tomato (2 mg/kg).

The TF for fat (US residue definition) is 0.03 (at 15 ppm feeding level)⁷². Assuming residues in vegetable waste are at the highest vegetable MRL (5 mg/kg for lettuce) and feeding at 100% of the diet the anticipated residues in fat are $5 \times 0.03 = 0.15$ mg/kg, below the US tolerance. Anticipated residues in milk are $5 \times 0.007 = 0.035$ mg/kg. If parent compound is monitored in tissues in other countries, as in Australia, residues in tissues are expected to be below the method LOQ.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Lambda-cyhalothrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops. It is registered on *Brassica vegetables* (APVMA permit) for the control of a cabbage cluster caterpillar and also for various pests on silver beet. The application rate is up to 9 g ai/ha. Cyhalothrin residues decline with typical half-lives of 30 and 5 days for soil and foliage respectively. Residues in cattle fat decline with a half-life of 7-9 days when animals are on “clean feed”.

Do not harvest for 2 days after application.

⁷² 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

There are Australian, Codex and USA MRLs for cyhalothrin in animal commodities. The relevant MRLs for cattle fat are 0.5 and 3 mg/kg for Australia and the USA respectively. The Australian MRL for milk is 0.5 [in the fat] mg/kg while the US one is 10 mg/kg for milk fat (reflecting 0.4 mg/kg in whole milk). The Codex MRLs are 3 mg/kg for fat and 0.2 mg/kg for milk. There is an Australian MRL for Brassica vegetables of 0.1 mg/kg, for chard 0.5 mg/kg and for various forages of 1 ppm.

If residues in vegetable waste fed to animals are assumed to be at the same level as the Brassica vegetable MRL, residues in fat (TF 0.3-0.5)⁷³ would be $0.1 \times 0.5 = 0.05$ mg/kg. The TF for milk is 0.02 giving anticipated maximum residues of $0.1 \times 0.02 = 0.002$ mg/kg for whole milk.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Linuron

-is a selective urea herbicide used for the control of various weeds in *carrots, parsnips, potatoes* and *onion* crops. The application rate is generally pre-emergence or early crop emergence (carrots, parsnips, potatoes 2.25 kg ai/ha) or in the case of onions when plants are at least 15 cm high with 3 or more leaves (0.27 kg ai/ha).

The harvest WHP is 6 weeks for carrots and not required for the other crops.

There are Australian and US but no Codex MRLs for linuron in animal commodities (residue definition in US and Australia: parent compound). The Australian MRLs are all *0.05 mg/kg, except for edible offal (mammalian) which is 1 mg/kg, while the US MRL for cattle fat is set at 0.2, liver and kidney 2 and milk 0.05 mg/kg. The Australian MRL for vegetables is *0.05 mg/kg except leek which is 0.2 mg/kg. The US MRLs for carrots, parsnips and potatoes are 1, 0.05 and 0.2 mg/kg respectively.

It is likely that the Australian MRLs need revision as the US MRLs are based on application at 1.68 kg ai/ha pre-emergence and early post-emergence.

No information was located on residues of linuron in onions. In trials on potatoes at 2.2.5 to 4.5 kg ai/ha, residues at harvest were <LOD to 0.4 mg/kg. In trials on carrots at 1/3 to 1/2 the Australian rates, residues in roots at harvest were <0.01-0.05 mg/kg and in tops/leaves 0.03-0.39 mg/kg (common moiety method).

The UK PSD and US EPA reported several animal feeding studies^{74,75}. In a study where two dairy cows (Guernsey) were fed at 1 ppm for 30 days, residues were not found in milk, lean meat or fat (<0.05 mg/kg); liver and kidney residues ranged from 0.4-0.7 mg/kg (common moiety method = linuron and its metabolites convertible to 3,4-dichloroaniline, calculated as linuron). In a separate study, 2 dairy cows (Guernsey) were fed at 50 ppm for 30 days. Residues in milk were 0.3-0.35 mg/kg. Lean meat and fat contained ca. 0.5 mg linuron/kg and liver and kidney 13 mg/kg (common moiety method).

⁷³ Cyhalothrin. (Environmental health criteria ; 99) 1.Pyrethrins - adverse effects 2.Pyrethrins - toxicity I. Series ISBN 92 4 154299 3 (NLM Classification: WA 240) ISSN 0250-863X

⁷⁴ Evaluation of fully approved or provisionally approved products. Issue 132: Evaluation on Linuron, May 1995, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

⁷⁵ Linuron Tolerance Reassessment Eligibility Decision Residue Chemistry Considerations PC Code 035506; Case 0047 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

Anticipated residues in liver and kidney tissues using the maximum trial residues at 28 days of 0.4 ppm are $0.4 \times 0.3 - 0.7 = 0.12 - 0.28$ mg/kg if measured using the common moiety method. No residues of intact linuron are expected in any tissues and residues would be expected to be below regulatory LOQs for countries monitoring the parent compound.

Livestock residues may exceed international and/or domestic market standards.

Maldison (malathion)

- is an organophosphate insecticide used for the control of various insects and nematodes. It is registered on *vegetables* for the control of aphids, red-legged earth mites, jassids, vegetable bugs, leaf hoppers etc. The application rate is up to 100 g ai/hL.

The harvest WHP is 3 days.

There are Australian and US but no Codex MRLs malathion in animal tissues. The relevant Australian and USA MRLs for malathion in animal tissues are 1 mg/kg in Australia and 4 mg/kg in the US. The Australian MRL for milk is 1 [in the fat] mg/kg while the US MRL is 0.5 mg/kg for milk fat (from application to dairy cows). The MRL for silverbeet, egg plant, garden pea, kohlrabi, peppers and root and tuber vegetables is 0.5 mg/kg, for kale and tomatoes 3 mg/kg and for other vegetables 2 mg/kg.

No residues of malathion were detected in tissues in a goat metabolism study conducted at a nominal feeding level of 115 ppm⁷⁶. There is no expectation of residues of malathion in tissues arising from the feeding of vegetable wastes derived from treated vegetables.

It is anticipated that animal product residues will be below typical method LOQs.

Maleic hydrazide

-is a plant growth regulator used to inhibit sprouting in *potatoes*, *onions* and *garlic*. The application rate is 2.75 kg ai/ha for potatoes, onions and garlic with spraying between 3 (onions and garlic) and 6 weeks before harvest.

No harvest WHP required.

There are no Australian, Codex or US MRLs for maleic hydrazide in animal commodities. The US MRLs are 32 mg/kg for kidney, 7 mg/kg for liver, 3 mg/kg for fat, 2.5 mg/kg for meat and 1 mg/kg for milk. The Australian and US MRLs for potatoes and onions are 50 and 15 mg/kg respectively.

The JMPR reported a PF for potatoes to potato peel (dry) of 3.3 giving an estimated maximum residue in peel of $50 \times 3.3 = 165$ ppm. Lactating cows dosed for 28 days at the equivalent of 11, 34 and 112 ppm in the diet with [¹⁴C]maleic hydrazide⁷⁷. Total radioactive residues in tissues for the highest dose group were 0.8, 3.9, 0.2 and 0.4 mg equiv/kg for liver, kidney, muscle and fat respectively. Characterization of radioactive residues in goat tissues showed combined residues of maleic hydrazide and its conjugates were 90-94% of the TRR in kidney and liver and 80-84% of the TRR in muscle and fat.

Livestock residues may exceed international and/or domestic market standards.

⁷⁶ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

⁷⁷ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

Mancozeb

- is a dithiocarbamate fungicide used on a variety of crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
Tomatoes	2.4	-	-
Onions	160 g ai/hL	7	-
Potatoes	2.4	-	-
Celery	1.76	7	-
Carrots	1.76	7	-
Lettuce	160 g ai/hL	14	-
Spinach, silver beet, beetroot	160 g ai/hL	14	-
Beans	2.4	7	-
Cucurbits	1.76	-	-

There are Australian, Codex and US MRLs for mancozeb in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The USA residue definition is zinc ethylenebisdithiocarbamate and the MRL 0.5 mg/kg for liver and kidney. The Australian and Codex MRLs for milk are *0.2 mg/kg and *0.05 mg/kg respectively.

There are Australian vegetable MRLs for beans (2 mg/kg), beetroot (1 mg/kg), onions (4 mg/kg as bulb vegetables), carrot (1 mg/kg), celery (5 mg/kg), cucurbits (2 mg/kg), lettuce, spinach and silver beet (5 mg/kg as leafy vegetables), potato (1 mg/kg) and tree tomato (T5 mg/kg). The Australian PAFC MRL is 50 ppm.

Residues on mancozeb on a variety of forage crops (bean straw, peanut foliage and sugar beet leaves) following applications at 1.5-4 kg ai/ha ranged from 0.1-9.3 ppm. Residues in vegetable waste would be expected to be less than 10 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study) was 0.003⁷⁸ giving an anticipated maximum residue from the feeding of vegetable waste of 10×0.003 = 0.03 mg/kg, less than the relevant international MRLs. The TF for milk was <0.008.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

MCPA (4-chloro-2-methylphenoxy)acetic acid)

-is a selective herbicide used for the control of broadleaf weeds in *peas*. Application is when the crop is 10-15 cm high but before flowering. It is applied at an application rate of up to 0.35 kg ai/ha. No harvest WHP is required.

Do not graze or cut for stock food for 7 days after application.

There are no Codex MRLs for MCPA in animal tissues. The Australian (parent) and US (parent + metabolite) residue definitions differ. The Australian MRL for meat (mammalian) is *0.05 mg/kg as is the milk MRL. The US MRL for meat is *0.1 mg/kg as is the milk MRL. Residues decline in soil and foliage with typical half-lives of 25 and 8 days respectively. There is no Australian MRL for peas.

⁷⁸ Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

(Scaling a residue of 88 ppm in forage for peas treated at 1 kg ai/ha to the application rate gives an estimated residue at day 0 of 31 ppm. Residues at 7 days after application, *ca.* one half-life are expected to be 15 ppm). Cattle and sheep fed low to moderate doses of MCPA in the diet for 2 weeks showed no residues on feeding at levels less than about 18 ppm⁷⁹. The major metabolite of MCPA is 2-methyl-4-chlorophenol in the free and conjugated form, which is formed in the liver..

In a feeding study where calves were fed in the diet at 250 or 500 ppm for 28 days, residues were <LOQ in meat and fat at slaughter and <LOQ for liver at the 250 ppm feeding level⁸⁰. Residues in kidney at 250 ppm feed level were 1.4 mg/kg. Residues in kidney and liver at the 500 ppm feed level were 0.14 and 2.3 mg/kg respectively. Residues at 7 days on clean feed after feeding at 500 ppm were 0.1 mg/kg in kidney. The half-life for depletion in tissues is estimated to be <2 days. Estimated TF for fat is $<0.1 \text{ mg/kg} \div 500 \text{ ppm} = <0.0002$ and for offal (kidney) is $1.4 \text{ mg/kg} \div 250 \text{ ppm} = 0.0056$. No residues are expected in milk of animals fed at up to 300 ppm in the diet. Anticipated residues in kidney are 0.084 mg/kg using conservative assumptions.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Metalaxy

- is a fungicide used on a variety of crops. It is used on vegetables as a pre-plant, seed bed or transplant application with rates up to 1 kg ai/ha for *potatoes* and 2 kg ai/ha for *carrots*, *cucurbits*, *Brassica vegetables* (cabbages etc) and *tomatoes*.

The harvest WHP is 7 days for cucurbits and Brassica vegetables and not required for tomatoes, carrots and potatoes.

There are Australian and US but no Codex MRLs for metalaxyl in animal commodities. The Australian and Codex residue definition is parent compound. The Australian MRLs for edible offal and meat are *0.05 mg/kg while the MRL for milk is *0.01 mg/kg. The US residue definition is the sum of metalaxyl and its metabolites containing the 2,6-dimethylaniline moiety, and N-(2-hydroxymethyl-6-methylphenyl)-N-(methoxyacetyl)-alanine methyl ester, each expressed as metalaxyl equivalents. The USA MRLs are 0.4 mg/kg for fat, liver and kidney and 0.05 mg/kg for meat and meat by-products and 0.02 mg/kg for milk. The Australian vegetable MRLs are 0.2 mg/kg for cucurbits and T0.1 mg/kg for the other vegetables.

In a lactating goat metabolism study conducted at a dose level equivalent of feeding at 7 ppm, radioactive residues in tissues, expressed in metalaxyl equivalents, were all <0.06 mg/kg⁸¹.

It is anticipated that animal product residues will be below typical method LOQs.

Metaldehyde

-is a molluscicide that is used for the control of slugs and snails in *vegetable* crops.

It is applied at an application rate of 0.75 kg ai/ha.

The harvest WHP is 7 days.

⁷⁹ MCPA. List A Reregistration Case 0017. Chemical No. 030501, 030502, 030516, 030564. Revised Product and Residue Chemistry Chapters for the Reregistration Eligibility Decision. DP Barcode: D299360

⁸⁰ Leng, M.L., Comparative metabolism of phenoxy herbicides in animals, in Fate of pesticides in large animals edited by Ivie, G.W. and Dorough, H.W., Academic Press, New York 1977.

⁸¹ 1982 JMPR Pesticide Residues in Food - 1982 Evaluations, FAO Plant Production and Protection Paper 49. FAO and WHO 1983

There are no Australian, Codex or US MRLs for metaldehyde in animal commodities. The Australian MRL for vegetables is 1 mg/kg.

No animal transfer data were located for this compound. Regulators have determined that residues are unlikely to occur in livestock commodities based upon the rapid degradation of metaldehyde in mammalian systems and the subsequent incorporation of degradates into naturally occurring components.

It is anticipated that animal product residues will be below typical method LOQs.

Methabenzthiazuron

-is a urea herbicide that is used for the control of various annual broad leafed weeds in *onions* (and leeks). The application rate is up to 2.1 kg ai/ha.

The harvest WHP is 7 weeks.

There are no Australian, Codex or US MRLs for animal commodities. The Australian MRL for onions is *0.05 mg/kg indicating that residues should not occur in the harvested crop.

It is anticipated that animal product residues will be below typical method LOQs.

Metham sodium

-is a soil fumigant used on various crops. It is registered for application to *vegetable* fields at 338 kg ai/ha.

No harvest WHP is required.

There are Australian but no Codex or US tolerances for metham sodium in animal commodities. It is assumed that residues from metham in animal tissues will be covered by the Codex MRLs for dithiocarbamates (as in Australia). The Australian MRL for edible offal is 2 mg/kg while the Codex MRL (dithiocarbamates) is 0.1 mg/kg, both measured as CS₂.

There are Australian vegetable MRLs, these range from 1 mg/kg for potato to 5 mg/kg for celery and leafy vegetables. The Australian PAFC MRL is 50 ppm. Residues in vegetable waste would be expected to be less than 10 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb) was 0.003⁸² giving an anticipated maximum residue from the feeding of vegetable waste of $10 \times 0.003 = 0.03$ mg/kg, less than the relevant international MRLs.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Methamidophos

-is an organophosphate insecticide used on various crops. It is used *on Brassica vegetables, capsicums, tomatoes and potatoes*. The application rate is 110 g ai/hL for Brassica vegetables, capsicum and tomatoes and 406 g ai/ha for potatoes.

The harvest WHPs are 4 days for tomatoes, 7 days for Brassica vegetables and potatoes and 14 days for capsicums.

There are Australian and Codex but not US MRLs for methamidophos in animal commodities. The Australian residue definition is parent compound. The Australian and Codex MRLs are *0.01 mg/kg for edible offal and meat mammalian while for milk are *0.01 and 0.02 mg/kg, respectively.

⁸² Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

It is assumed that in the US residues of methamidophos in animal tissues are assumed to be covered by the acephate MRLs (acephate residue definition is the sum of acephate and methamidophos). The US MRLs for vegetable ranges from 0.1 to 1 mg/kg.

The Australian MRLs for Brassicas vegetables, tomatoes, capsicums (peppers) and potatoes are 1, 2, 2 and 0.25 mg/kg respectively. In animal transfer studies with lactating cattle fed mixtures of acephate and methamidophos the transfer factors for muscle and kidney were 0.008 and 0.017 respectively⁸³. The TF for methamidophos in milk is 0.004. The 2003 JMPR reported a processing factor of 3.8 for dry tomato pomace. Anticipated residues in kidney on feeding tomato pomace are $2 \times 3.8 \times 0.017 \times 0.3 = 0.04$ mg/kg. Conservative assumptions were used in this assessment.

Livestock residues are not anticipated exceed international and/or domestic market standards (low risk).

Methazole

-is a herbicide used for the control of weeds in *onions*.

Probe Selective Herbicide was registered for the control of a number weeds in onions. The product is no longer manufactured or registered. In order to avoid problems with disposal of the product on hand, this permit(3131) was issued to allow use of the remaining stocks of the product in a manner for which it was originally registered.

The Australian MRL for onions is T*0.1 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Methidathion

- is an organophosphate insecticide used for the control of insects and mites in vegetables.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Beans</i>	0.56	7	-
<i>Brassica vegetables</i>	0.56	7	-
<i>Eggplants</i>	0.56	7	-
<i>Lettuce</i>	0.56	7	-
<i>Onions</i>	0.3	7	-
<i>Peas</i>	0.56	7	-
<i>Potatoes</i>	0.56	7	-
<i>Tomatoes</i>	1.12	7	-

There are Australian and Codex but no USA MRLs for methidathion in animal tissues. The Australian (Codex) and USA residue definitions differ: methidathion (Australia, Codex), sum of methidathion, its oxygen analogue, the sulfoxide and the sulfone (USA). The Australian and Codex that apply to animal tissues are 0.5 and *0.02 mg/kg respectively. The corresponding milk MRLs are 0.5 [in the fat] and 0.001 mg/kg.

⁸³ 2003 JMPR. Pesticide Residues in Food - 2003 Evaluations – Part I: Residues, FAO Plant Production and Protection Paper xxx. FAO and WHO 2004

The Australian MRLs for Brassicas vegetables (0.1 mg/kg), tomatoes (0.1 mg/kg), lettuce (1 mg/kg), onions (*0.01 mg/kg), and other vegetables (0.1 mg/kg).

No residues of methidathion were observed in tissues of cows fed at up to 50 ppm in the diet when measured by the Australian or USA residue definitions⁸⁴.

It is anticipated that animal product residues will be below typical method LOQs.

Methiocarb

is a carbamate molluscicide and is used in *vegetables* to control snails. The application rate is 0.44 kg ai/ha.

The harvest WHP is 7 days.

Do not graze or cut for stock food for 7 days after application.

There no Australian, Codex or US MRLs for methiocarb residues in animal commodities.

The Australian MRL for vegetables is 0.1 mg/kg.

The 1981 JMPR reported the results of beef and dairy cattle feeding studies where cattle were fed rations containing 10, 30 and 100 ppm methiocarb for 29 days⁸⁵. Residues were detected only in the liver (animals fed 30 and 100 ppm methiocarb) and kidney (animals fed 100 ppm methiocarb). All other tissues (brain, heart, muscle and fat) showed no detectable residues.

It is anticipated that animal product residues will be below typical method LOQs.

Methomyl

- is a carbamate insecticide used for the control of heliothis and loopers in cotton.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Beans</i>	0.45	1	-
<i>Brassica vegetables</i>	0.45	1	-
<i>Capsicums (peppers)</i>	0.45	1	-
<i>Lettuce</i>	0.45	1	-
<i>Peas</i>	0.45	1	-
<i>Potatoes</i>	0.45	-	-
<i>Sweet corn</i>	0.45	1	3
<i>Tomatoes</i>	0.45	1	-

Methomyl residues decline with typical half-lives of 7 and 4 days for soil and foliage respectively.

There are Australian and Codex but no USA MRLs for methomyl (as thiodicarb) in animal tissues. The MRLs have all been set at the LOQ.

⁸⁴ Methidathion Reregistration Eligibility Decision Residue Chemistry Considerations Shaughnessy No. 100301; Case No. 0034 Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division
⁸⁵ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982

Australian MRLs for the various vegetable crops are cabbages 2 mg/kg, leafy vegetables and legume vegetables 1 mg/kg, fruiting vegetables other than cucurbits (tomatoes, eggplant etc) 1 mg/kg, sweet corn (corn-on-the-cob) 0.1 mg/kg and potatoes 1 mg/kg.

No residues of methomyl/thiodicarb were observed in tissues (<0.01 mg/kg) of cows fed at up to 86 ppm in the diet when measured by the Australian or USA residue definitions⁸⁶.

It is anticipated that animal product residues will be below typical method LOQs.

Methoxyfenozide

- is an insecticide used for the control of heliothis (native budworm and tomato grub) in *tomatoes*.

The application rate is up to 0.41 kg ai/ha.

A harvest WHP is not required

Do not allow livestock to graze any treated crop.

Do not cut for stock feed.

There are Australian, Codex and USA MRLs for methoxyfenozide in animal tissues. The Australian MRLs have all been set at the LOQ (*0.01 mg/kg). The Codex MRLs are 0.05 mg/kg for fat, 0.02 mg/kg for edible offal and 0.01 mg/kg for milk. The US tolerances are 0.5 mg/kg for fat, 0.02 mg/kg for meat and 0.1 mg/kg for milk. The Australian MRL for fruiting vegetables other than cucurbits is 3 mg/kg.

Residues in perirenal fat of cows ranged 0.007 to 0.011 mg/kg on feeding at the equivalent of 15 ppm in the diet for 28 days; 0.018 to 0.082 mg/kg on feeding at 45 ppm and 0.16 to 0.44 mg/kg on feeding at 150 ppm⁸⁷.

It is anticipated that animal product residues will be below typical method LOQs.

Metiram

- is a dithiocarbamate fungicide used on a variety of crops. It is used on vegetables for the control of various fungal diseases

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Asparagus</i>	2.45	7	-
<i>Beans</i>	2.45	7	-
<i>Brassica vegetables</i>	2.45	7	-
<i>Carrots</i>	1.54	7	-
<i>Celery</i>	1.54	2	-
<i>Cucumbers</i>	1.54	2	-
<i>Cucurbits except cucumber</i>	1.54	7	-
<i>Lettuce</i>	1.54	7	-
<i>Potatoes</i>	1.75	7	-
<i>Tomatoes</i>	1.54	2	-

⁸⁶ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

⁸⁷ Public Release Summary on Evaluation of the new active METHOXYFENOZIDE in the product PRODIGY 240 SC INSECTICIDE, National Registration Authority for Agricultural and Veterinary Chemicals, May 2002, Canberra Australia

There are Australian and Codex but no US MRLs for metiram in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂.

The Australian PAFC MRL is 50 ppm and brassicas MRL 2, cucurbits 2 and other vegetables 3 mg/kg. Residues in vegetables, culls and waste would be expected to be less than 50 ppm. The target tissue is liver. The TF for liver (1000 ppm feeding study) was 0.01⁸⁸ giving an anticipated maximum residue from the feeding of vegetables, culls and waste at 100% of the diet of 50×0.01 = 0.5 mg/kg, less than the relevant international MRLs (metiram residues are measured as CS₂ and would not be distinguished from other dithiocarbamate residues).

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Metolachlor

-is a selective herbicide used for the control of annual grasses and broadleaf weeds in cotton, maize, sweet corn and sorghum. It is applied pre-emergent or at the time of transplanting of seedlings (Brassica vegetables, tomato).

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (weeks)	Grazing WHP (weeks)
Green beans	2.88	10	10
Brassica vegetables	2.88	-	-
Sweet corn	2.88	-	-
Sweet potato	2.16	23	23
Tomato	1.92 (S-metolachlor)	-	-

There are no Codex MRLs for metolachlor in animal tissues. The Australian (parent) and US (parent + metabolite) residue definitions differ. The relevant US MRLs for animal tissues are 0.02 mg/kg for cattle meat, 0.2 mg/kg for cattle kidney and 0.02 mg/kg for milk. The Australian MRLs for meat (mammalian) and milk are *0.05 mg/kg. Residues decline in soil and foliage with typical half-lives of 90 and 5 days respectively. The Australian MRLs for beans, Brassica vegetables, sweet corn (kernels) and sweet potato are *0.02, *0.02, 0.1 and *0.2 mg/kg. The MRL for tomato is T*0.01 mg/kg. Metolachlor has a primary animal feed commodity MRL of 5 mg/kg.

The US EPA reported⁸⁹ that “Adequate residue data are also available for legume vegetable foliage. Following a PPI application of metolachlor at 3.0 lb ai/A (1× = 3.36 kg ai/ha), combined residues were 0.44-11.5 ppm in/on pea and bean forage (vines) harvested 52-71 days post-treatment and 0.31-2.2 ppm in/on pea and bean hay harvested 100-122 days post-treatment.”

Adequate residue data are available on both field and sweet corn reflecting the use of metolachlor (EC and G) as a combined PPI and post-emergence layby application, each at 3.36 kg ai/ha (6.7 kg ai/ha/season, 1×); however, additional data are required for aspirated grain fractions. Combined residues were <0.12-3.02 ppm in/on field corn forage collected 29-32 days posttreatment and 0.27-3.1 ppm in/on sweet corn forage and <0.08-<0.10 ppm in/on ears (K+CWHR) collected 29-50 days

⁸⁸ Evaluation of fully approved or provisionally approved products. Issue 36: Evaluation on ethylenebisdithiocarbamates (2), April 1991, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

⁸⁹ Revised Metolachlor and S-Metolachlor Residue Chemistry Chapter for the Tolerance Reassessment Eligibility Decision (TRED); PC codes 108801 and 108800; DP Barcode D282931; Rereg. Case 0001. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

post-treatment. At maturity, combined residues were <0.08 ppm in/on field corn grain and 0.11-1.33 ppm in/on field corn fodder. Data are also available from recent bridging studies using field and sweet corn to compare residues of metolachlor and *S*-metolachlor. In eight side-by-side field corn trials, residues of metolachlor were 0.12-2.75 ppm in/on forage (30 days post-treatment), <0.10-2.81 ppm in/on fodder, and <0.08 ppm in/on grain harvested following PPI and post-emergence applications (3.36 + 3.36 kg ai/ha) of metolachlor (EC) totaling 6.72 kg ai/ha. Following a PPI + post-emergence application of *S*-metolachlor (EC) at 2.1 + 2.1 kg ai/ha/application (4.48 kg ai/ha/season, 1×), combined residues were <0.09-2.23 ppm in/on forage (30 days post-treatment), <0.08-1.12 ppm in/on fodder, and <0.08 ppm in/on grain.

In four side-by-side sweet corn trials, residues of metolachlor were 0.67-5.75 ppm in/on forage (29-33 days post-treatment), 0.31-5.54 ppm in/on fodder, and <0.08 ppm in/on ears (K+CWHR) harvested following PPI and post-emergence applications (3.36 + 3.36 kg ai/ha) of metolachlor (EC) totaling 6.7 kg ai/ha. Following PPI + post-emergence applications of *S*-metolachlor at 2.2 + 2.2 kg ai/ha/application (4.48 kg ai/ha/season, 1×), combined residues were 0.35-4.44 ppm in/on forage (29-33 days post-treatment), <0.08-2.29 ppm in/on fodder, and <0.08 ppm in/on ears (K+CWHR).

The US EPA also noted that *“In the available ruminant feeding study, dairy cows were administered metolachlor at a level equivalent to 60 ppm in the feed for up to 28 consecutive days. There were no detectable residues of CGA-37913 (<0.006 ppm) or CGA-49751 (<0.01 ppm) in any of the milk samples, and there were no detectable residues of CGA-37913 (<0.02 ppm) and CGA-49751 (<0.02 ppm) in any tissues except liver or kidney. If residues in beef muscle are corrected for decline of CGA-37913 residues during storage, the maximum combined residues in beef muscle would be <0.06 ppm. At each sampling interval, residues in liver were comprised of CGA-37913 at 0.11 ppm and CGA-49751 at 0.02 ppm, for combined residues of 0.13 ppm. In kidney, residues of CGA-37913 were 0.14-0.36 ppm and residues of CGA-49751 were 0.05-0.06 ppm, for combined residues of 0.20-0.42 ppm.”*

The TF for muscle is 0.001 and for kidney 0.007.

In a study cows were fed 60 ppm metolachlor in the diet for up to 28 days (equivalent to 2.4 mg ai/kg bw/day). Metolachlor residues in meat and fat were all below the LOQ (<0.02 mg/kg); and residues in milk were all <LOQ (<0.01 mg/kg). In contrast, finite residues of ~0.4 mg/kg for kidney and ~0.1 mg/kg for liver were reported.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Metribuzin

- is a herbicide used on a variety of crops. It is used on vegetables for the control of various weeds. The application rate is 0.525 kg ai/ha for *peas* and 0.713 kg ai/ha for *potatoes* and *tomatoes*. The harvest WHP is 21 days for tomatoes and not required for potatoes and peas.

There are Australian and US but no Codex tolerances for metribuzin in animal tissues. The Australian and US residue definitions differ with the Australian one being parent compound and the US one including the triazinone metabolites of metribuzin. The Australian animal commodity MRLs have all been set at *0.05 mg/kg while the US MRLs for animal tissues have all been set at 0.7 mg/kg kg and 0.05 mg/kg for milk.

The Australian MRLs for the vegetables listed above have been set at *0.05 mg/kg, except tomatoes and asparagus for which the MRL is 0.1 and 0.2 mg/kg, respectively. There is a PAFC MRL of 0.2 mg/kg.

The US EPA reported beef and dairy cattle feeding studies where animals were fed at 3 or 10 ppm in the diet for up to 30 days⁹⁰. Residues were less than the limit of detection in muscle. The TF for fat (10 ppm feed level) was 0.11 while at the 3 ppm feed level it was 0.02. It is unclear why the TF calculated for the 10 ppm feed level should be so much higher than the 3 ppm (also noting the octanol water partition coefficient). It is possible there is saturation of excretion pathways. The 3 ppm transfer factor is considered appropriate as it is closer to the anticipated exposure level. The TF for milk at the 10 ppm feed level was 0.0007.

It is anticipated that animal product residues will be below typical method LOQs.

Napropamide

is a herbicide used to control certain grass weeds in broad acre crops, tomatoes and grapes. The application rate is 3.35 kg ai/ha with application to direct seeded and transplanted *tomatoes*.

No WHP required.

Do not graze treated areas.

There are no Australian, Codex or US MRLs for animal tissues. The Australian MRL for tomatoes is *0.1 mg/kg.

EFSA reported that when ¹⁴C-napropamide was administered orally to two lactating goats at a dose rate corresponding to 9.9 ppm in the feed the radioactivity in liver and kidney was 0.153 and 0.0365 mg/kg respectively. In other tissues and milk TRR were very low (<0.01 mg/kg). traces of napropamide and desethyl-napropamide were identified in liver (<0.001 mg/kg). In the kidney napropamide amounted to 0.001 mg/kg. All other single fractions and components amounted to <0.01 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Norflurazon

-is a fluorinated pyridazinone herbicide used for the pre-emergent control of annual grasses and broadleaf weeds in cotton, citrus, grapes and stone fruit etc. It is applied to *asparagus* at an application rate of up to 2 kg ai/ha after harvesting and before young fern appears.

The harvest WHP is 14 days.

There are no Australian or Codex MRLs for norflurazon in animal tissues. The Australian (parent) and US (parent + metabolite) residue definitions differ. The relevant US MRLs for animal tissues are 0.5 mg/kg for cattle liver and 0.1 mg/kg for other tissues and milk. The MRL for asparagus is 0.05 mg/kg.

While the information available is limited, a goat metabolism study suggests residues of parent compound are not expected in cattle tissue from the feeding of asparagus or processing waste from asparagus treated with norfluazuron.

⁹⁰ Reregistration Eligibility Decision Metribuzin LIST A CASE 0181EPA 738-R-97-006 February 1998. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

NOTE: US MRLs have been established for animal feed items (alfalfa forage and hay at 3 and 5 ppm respectively) as well as for animal commodities. If the US MRLs are used to estimate the dietary burden using the US EPA Guideline, a dietary burden of 7.7 ppm is estimated (3 ppm grass forage, 35% DM, 70% diet + 5 ppm hay, 89% DM 30% diet). An anticipated TF is the 0.25 ppm (animal commodity tolerances, liver) ÷ 7.7 ppm (dietary burden) = 0.03 (crude estimate). An anticipated TF is the 0.1 ppm (animal commodity tolerances, fat) ÷ 7.7 ppm (dietary burden) = 0.01 (crude estimate).

It is anticipated that animal product residues will be below typical method LOQs.

Omethoate

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *onions* (0.55 kg ai/ha) and *potatoes* (60 g ai/hL). The harvest WHP is 14 days for onions and 7 days for potatoes.

There are Australian but no Codex or US MRLs for omethoate in animal tissues. The Australian MRLs for animal commodities including milk have been set at *0.05 mg/kg. There is an Australian MRL for vegetables of 2 mg/kg and one at 20 ppm for a series of miscellaneous forage and fodder crops.

A metabolism study with lactating goats dosed orally with dimethoate suggests that residues of omethoate are not expected in animal tissues⁹¹. In an animal transfer study conducted at the equivalent of 10 and 20 ppm in the feed for 14 days, residues in tissues were <0.02 mg/kg except for a residue in fat of 0.02 mg/kg for the 10 ppm dose group⁹². Residues in milk reached a maximum of 0.08 mg/kg but declined rapidly on cessation of dosing to be <0.02 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Oxadixyl

- is a fungicide used on a variety of crops. It is used on *cucurbits*, *lettuce* and *onions* for the control of downy mildew at an application rate of 0.2 kg ai/ha. The harvest WHP is 3 days for cucurbits and lettuce and 14 days for onions.

There are no Australian, Codex or US MRLs for oxadixyl in animal tissues. The Australian MRL for cucurbits is 0.5 mg/kg, lettuce 1 mg/kg and onions 0.5 mg/kg.

The log P_{ow} for oxadixyl is 0.75 indicating little propensity for accumulation in fat. Predicted TFs for offal and fat based on the log P_{ow} are 0.023 and 0.012. Maximum anticipated residues in tissues would be 1×0.023 = 0.023 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

OxamyI

-is a nematicide used on various crops. It is used on *tomatoes* for the control of root knot nematode at an initial application rate of 4.32 kg ai/ha with subsequent applications at 0.48 kg ai/ha.

⁹¹ 1998 JMPR - Pesticide Residues in Food - 1998 Evaluations, Part I Residues FAO Plant Production and Protection Paper 152/1. FAO and WHO 1999

⁹² UK PSD Evaluation of fully approved or provisionally approved products: Issue No. 83 omethoate November 1993

There are Australian and Codex but no US MRLs for oxamyl in animal commodities. The Australian and Codex MRLs have all been set at *0.02 mg/kg. The Australian MRL for tomatoes is *0.05 mg/kg.

In a livestock-feeding study oxamyl was fed to Guernsey dairy cows at 2, 10 or 20 mg/kg in the diet for 30 days⁹³. No residues of oxamyl were detected (<0.02 mg/kg) in any sample of milk or milk fractions, liver, kidney, lean muscle or subcutaneous fat at any of the feeding levels.

It is anticipated that animal product residues will be below typical method LOQs.

Oxycarboxin

is an oxathiin fungicide used for the control of rusts in *green beans*. The application rate is 0.75 kg ai/ha.

The harvest WHP is 7 days.

There are no Australian, Codex or US MRLs for oxycarboxin in animal commodities. The Australian MRLs for beans have been set at 5 mg/kg.

No information on oxycarboxin residues in bean hay/forage or any animal transfer data were located. Scaling anticipated residues on day 0 of 88 ppm in forage following application at 1 kg ai/ha gives estimated residues of 66 ppm in forage.

Oxycarboxin (carboxin sulfoxide) is the main breakdown product of carboxin⁹⁴. Only trace amounts of carboxin were found in rat tissues 48 hours after dosing. In milk cows fed carboxin at up to 5 ppm for 10 days, less than 2% of the administered dose was found in tissues, however, significant levels were found in milk a few days after exposure.

The log P_{ow} for oxycarboxin is 0.75 indicating little propensity for accumulation in fat. Predicted TF for offal and fat using empirical relationships between TF and the log P_{ow} are 0.023 and 0.012 respectively. Maximum anticipated residues in tissues (offal) would be 66×0.023 = 1.5 mg/kg.

Livestock residues may exceed international and/or domestic market standards. Insufficient data were located to provide confident opinion on livestock residue risks.

Oxyfluorfen

- is a diphenyl ether herbicide used for the control of weeds in various crops. It is applied prior to transplanting *Brassica vegetable* (0.48 kg ai/ha) and *onion* seedlings (0.12 kg ai/ha).

There is no harvest WHP.

Do not graze treated weeds

There are Australian and US but no Codex MRLs for oxyfluorfen in animal commodities. The Australian MRLs have all been set at *0.01 and the US ones also at *0.01 m/kg. The Australian

⁹³ 1980 JMPR Pesticide Residues in Food - 1980 Evaluations, FAO Plant Production and Protection Paper 26 Sup. FAO and WHO 1981

⁹⁴ CARBOXIN (Case No. 0012; PC CODE 090201) RED - Reregistration Eligibility Decision, Product Chemistry Considerations, August 2, 2003, Contract No. 68-W-99-053, Submitted to: U.S. Environmental Protection Agency, Arlington, VA, Submitted by: Dynamac Corporation, 20440 Century Boulevard, Suite 100, Germantown, MD 20874

MRLs for Brassica vegetables and onions have been set at *0.05 mg/kg. The TF for fat is 0.035 and for milk is 0.003⁹⁵.

It is anticipated that animal product residues will be below typical method LOQs.

Oxythioquinox (chinomethionat)

- is used for the control of powdery mildew and mites on *cucurbits*. The application rate is 125 g ai/ha.

The harvest WHP is 7 days.

There are no Australian, Codex or US MRLs for oxythioquinox in animal commodities.

The Australian MRL for cucurbits is 0.5 mg/kg.

The JMPR have reported an animal transfer study in which a dairy cow was given doses of ¹⁴C-labelled chinomethionat, twice daily for 24 days, equivalent to a rate of 0.0675 mg/kg body weight/day⁹⁶. This is approximately equivalent to 1.68 ppm in the diet. The only ¹⁴C tissue residue detected after the 25th day was 0.05 mg equiv./kg in liver and the highest milk residue was 0.002 mg equiv./kg.

It is anticipated that animal product residues will be below typical method LOQs.

Paraquat

- is a herbicide used for the control of weeds in various crops. The application rate for *vegetables* is up to 0.4 kg ai/ha. In the case of *potatoes* application can be made as a pre-harvest desiccant at 0.7 kg ai/ha.

The following grazing restraints apply:

Do not graze or cut sprayed vegetation for stock food for 1 day after application. Remove stock from treated areas at least 3 days before slaughter

The Australian and Codex MRLs for paraquat in kidney are 0.5 and 0.05 mg/kg while in milk the MRL are *0.01 and 0.005 mg/kg, respectively. The US MRL for kidney is 0.5 mg/kg and for milk 0.01 mg/kg. Residues in soil and foliage decline with typical half-lives of *ca.* 1000 and 30 days respectively. The MRL for potatoes is 0.2 mg/kg and for other vegetables *0.05 mg/kg. There is a PAFC MRL of 500 ppm.

For residues in kidney to be less than the US MRL of 0.3 mg/kg, cattle would have to be fed at less than *ca.* 80 ppm in the diet. Noting the application rates and that the MRLs for vegetables (0.05 mg/kg) it is considered unlikely that residues in vegetables would exceed 80 ppm.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Parathion-methyl

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *vegetable* crops at application rates up to 0.35 kg ai/ha.

The harvest WHP is 14 days.

⁹⁵ Reregistration Eligibility Decision (RED) Oxyfluorfen List A Case 2490, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

⁹⁶ 1977 JMPR - Pesticide Residues in Food - 1977 Evaluations, FAO Plant Production and Protection Paper 10 Suppl. FAO and WHO 1978

Do not graze or cut for stock food for 14 days after application

There are Australian but no Codex or US MRLs for parathion methyl in animal commodities. The Australian MRLs for animal commodities have been set at T*0.05 mg/kg.

There are Australian MRLs of *0.05 mg/kg for potatoes, *0.1 mg/kg for sweet corn, T0.1 mg/kg for Brassica vegetables, T0.2 mg/kg for fruiting vegetables other than cucurbits, T0.5 mg/kg for carrots and legume vegetables, T1 mg/kg for leafy vegetables and cucurbits and T3 mg/kg for celery. There is also an MRL at T25 ppm for legume animal feeds.

A metabolism study with lactating goats dosed orally with parathion methyl at the equivalent of 6.25 ppm in the diet suggests that residues of parathion methyl are not expected in animal tissues⁹⁷. However, considering that the likely maximum exposures levels are greater than the feeding/dosing level in the goat metabolism study, the data are inadequate to draw conclusions about likely residues in cattle or sheep.

Insufficient data were located to provide confident opinion on livestock residue risks.

Pebulate

-is a thiocarbamate herbicide used for weed control in direct seeded and transplanted *tomato* seedlings. The application rate is 5.76 kg ai/ha.

A harvest WHP is not required.

There are no Australian, Codex or US MRLs for pebulate in animal commodities. The Australian MRL applicable to tomatoes is set at *0.1 mg/kg (fruiting vegetables other than cucurbits).

The US EPA reported that⁹⁸ "*Pebulate has an early season soil-incorporated application with extensive soil degradation, soil dissipation, and plant metabolism. No parent compound is identified in plant metabolism studies. Major metabolites found in plants are a series of three different butylamine compounds resulting from hydrolysis of the thiocarbamate moiety; these metabolites are not of toxicological concern at the concentrations expected from registered uses of pebulate (9). Pebulate residues were below the limit of quantitation in all field trials and processing studies.*

Pebulate was identified at low levels in milk and fat in livestock metabolism studies using greatly exaggerated doses (up to 223×). However, livestock dietary exposure is expected to be negligible even when using conservative assumptions for livestock diets."

It is anticipated that animal product residues will be below typical method LOQs.

Penconazole

-is a fungicide used for the control of ring spot on *Brussels sprouts*. It is applied as a foliar spray at an application rate of 25 g ai/ha.

The harvest WHP is 7 days

There are Codex but no Australian or US MRLs for penconazole in animal tissues. The Codex MRLs are *0.05 mg/kg for cattle meat and edible offal and *0.01 mg/kg for cattle milk. The Australian MRL for Brussels sprouts is 0.05 mg/kg.

⁹⁷ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

⁹⁸ Reregistration Eligibility Decision Pebulate List B Case 2500EPA 738-R-99-005 November 1999

Milk, muscle and fat residues (radioactivity) in a goat metabolism study where lactating goats were orally dosed at a rate equivalent to 5 ppm in the feed were <0.017 mg equiv./kg⁹⁹.

It is anticipated that animal product residues will be below typical method LOQs.

Pencycuron

-is a phenylurea fungicide used for the control of black scurf in *potatoes*. The application rate is 25 g ai/100 kg of seed potato.

A harvest WHP is not required.

There are no Australian, Codex or US MRLs for pencycuron in animal commodities. The Australian MRL for potatoes is 0.05 mg/kg.

Noting the likely exposure of animals to pencycuron in potatoes it is concluded that there is low probability of detectable residues in tissues of food producing animals which might be fed potatoes grown from treated tubers.

It is anticipated that animal product residues will be below typical method LOQs.

Pendimethalin

-is a selective dinitroaniline herbicide used for the control of annual ryegrass and certain broadleaf weeds in cotton, cereals etc. It is applied post-plant pre-emergent to *broad beans* (1.32 kg ai/ha), *carrots* (0.99 kg ai/ha), *French beans* (1.32 kg ai/ha), *processing peas* (1.32 kg ai/ha) and *onions* (0.66 kg ai/ha) and soil pre-transplanting *Brassica vegetables* (0.99 kg ai/ha) and *lettuce* (1.32 kg ai/ha).

No harvest or grazing WHPs are required.

There are Australian but no Codex or US MRLs for pendimethalin in animal tissues. The Australian MRL for animal commodities have all been set at *0.01 mg/kg. Residues decline in soil and foliage with typical half-lives of 90 and 50 days respectively. The Australian MRL for vegetables are *0.05 mg/kg. The US EPA notes that animal metabolism studies in goats conducted at exaggerated feeding levels indicate that there is no reasonable expectation for residues of pendimethalin in tissues¹⁰⁰.

It is anticipated that animal product residues will be below typical method LOQs.

Permethrin

- is a synthetic pyrethroid insecticide used for the control of various insects in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Brassica vegetables</i>	0.1	2	-
<i>Celery</i>	25 g ai/hL	1	-

⁹⁹ 1992 JMPR - Pesticide Residues in Food – 1992 evaluations. Part II. Toxicology. WHO, WHO/PCS/93.34, Geneva, 1993

¹⁰⁰ Reregistration Eligibility Decision Pendimethalin List A Case 0187, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Green beans</i>	0.1	3	-
<i>Green peas</i>	0.125	3	-
<i>Lettuce</i>	10 g ai/hL	2	-
<i>Potatoes</i>	0.1	2	-
<i>Sweet corn</i>	0.125	2	-
<i>Tomatoes</i>	0.1	2	-

Permethrin residues decline with typical half-lives of 30 and 8 days for soil and foliage respectively.

There are Australian, Codex and USA MRLs for permethrin in animal tissues. The Australian and Codex residue definitions are parent compound while the USA residue definition includes some metabolites. The relevant MRLs for fat are 1, 1 and 1.5 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for offal are 0.5, 0.1 and 0.1 mg/kg for Australia, Codex and the USA respectively. The relevant MRLs for milk are 0.1 F, 0.1 F and 3 mg/kg for Australia, Codex and the USA respectively, the latter is for milk fat and represents 0.25 mg/kg on a whole milk basis.

Australian MRLs for vegetables include Brussels sprouts 2 mg/kg, other Brassica vegetables and peas 1 mg/kg, celery 5 mg/kg, beans 0.5 mg/kg, leafy vegetables 5 mg/kg, potato 0.05 mg/kg, sweet corn (corn-on-the-cob) *0.05 mg/kg and tomato 0.4 mg/kg. There is an Australian animal feed MRL for pea vines (green) of 15 ppm.

The 1980 JMPR reported residues of permethrin in sweet corn stover of 0.99-18 ppm (mean 7.2 ppm) at 0-4 days after 8 applications at 0.11 kg ai/ha. The same review reported processing data for tomatoes. Residues in tomato pulp (wet) were 10-50× those in whole tomatoes (mean PF 25). The dry matter content of tomato pulp is typically 25%.

The TF for fat is 0.04¹⁰¹. Residues sweet corn stover could be as high as 18 ppm. Anticipated maximum residues in fat resulting from feeding sweet corn waste at 100% of the diet are 18×0.04 = 0.72 mg/kg. The TF for milk is 0.002 and if fed at 18 ppm would give rise to residues in whole milk of 0.036 mg/kg, less than the relevant international standards.

Residues in tomato pulp (wet) are expected to be no more than 25×0.4 = 10 ppm. Residues in fat from feeding tomato pomace at 30% of the diet are expected to be less than 0.3×10×0.04 = 0.12 mg/kg. The residues in fat were reported to decline with an initial half-life of < 7 days. The TF for milk is 0.002 and if fed at 10 ppm would give rise to residues in whole milk of 0.3×10×0.002 = 0.006 mg/kg, less than the relevant international standards.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Phenmedipham

-is a carbamate herbicide used for weed control in *beet crops*. The application rate is 1.33 kg ai/ha.

No harvest WHP is required.

There are Australian but no Codex or US MRLs for phenmedipham residues in animal commodities. The Australian MRLs have all been set at *0.1 mg/kg. The Australian MRL for

¹⁰¹ 1981 JMPR Pesticide Residues in Food - 1981 Evaluations, FAO Plant Production and Protection Paper 42. FAO and WHO 1982

beetroot is *0.1 mg/kg. The US has tolerances of 0.5 mg/kg for dried sugar beet pulp, and 0.2 mg/kg for sugar beet molasses. The US EPA¹⁰² reported that phenmedipham residues concentrated 3× and 1.3× more in dried sugar beet pulp and molasses, respectively. The US tolerance for raw sugar beet roots and tops is 0.1 mg/kg. The use pattern in the US is application at up to 1.12 kg ai/ha with a pre-harvest interval of 60 days for garden beets and 75 days for sugar beets.

The US EPA also reported results of trials on fresh-market spinach. Residues of treated spinach harvested 20-24 days post-treatment at up to 1.12 kg ai/ha ranged from <0.05 mg/kg (below the method level of quantification) to 3.6 mg/kg.

Insufficient data were located to provide confident opinion on livestock residue risks.

Phorate

- is an organophosphate insecticide used for the control of various insects in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (weeks)	Grazing WHP (weeks)
<i>Brassica vegetables</i>	1.7	10	-
<i>Brussels sprouts</i>	2.2	10	-
<i>Tomatoes</i>	1.5	10	-
<i>Carrots</i>	1	10	-
<i>Onions</i>	1.5	10	-
<i>Potatoes</i>	2.9	13	-

There are Australian and Codex but no US MRLs for phorate in animal commodities. The Australian MRLs for animal commodities have all been set at *0.05 mg/kg. The Codex MRL for animal tissues is *0.02 and that of milk is *0.01 mg/kg. The residue definition for Australia and Codex is the sum of phorate, its oxygen analogue, and their sulfoxides and sulfones, expressed as phorate while in the USA it is the sum of phorate and its cholinesterase-inhibiting metabolites. This should have no impact as they are essentially the same. There is an Australian MRL of 0.5 mg/kg for vegetables.

In a ruminant feed study with animals dosed at the equivalent of a feeding level of 1.39 and 3.1 ppm, no residues were detected in any tissue or milk¹⁰³. Note the higher feeding level is considered the maximum practical limit for feeding as animals exposed to higher levels resulted in clinical signs of organophosphate poisoning and death.

It is anticipated that animal product residues will be below typical method LOQs.

Piperonyl butoxide (PBO)

- is a synergist used to increase the effectiveness of various synthetic pyrethroid (SP) insecticides. It is registered for use with various SPs but particularly pyrethrin in the control of insect pests on vegetables. The application rate is up to 30 g ai/hL.

The harvest WHP is 1 day.

¹⁰² Reregistration Eligibility Decision (RED) for Phenmedipham List A Case No. 0277 Approved by: Debra Edwards, Special Review and Reregistration Division Date: March 31, 2005

¹⁰³ PHORATE: Revised HED Chapter of the Reregistration Eligibility Decision Document (RED), Case #0103, PC Code 057201; Barcode No. D253368

There are Australian and Codex but no US MRLs for PBO in animal commodities. PBO is exempt from the requirement for tolerances in the US. The Australian MRLs for animal tissues have all been set at 0.1 mg/kg. The Codex MRL for mammalian meat (fat) (except cattle) is 2 mg/kg and for cattle meat (fat) 5 mg/kg. The Australian MRL for milks is 0.05 mg/kg. There is an Australian MRL of 8 mg/kg for vegetables.

The TF for PBO in fat is 0.004 (feeding at 100 ppm in the diet)¹⁰⁴ resulting in an anticipated maximum residue from feeding vegetables with residues at the same level as the MRL of 0.032 mg/kg, less than the relevant Australian and Codex MRL.

The TF for PBO in milk is 0.0001 (feeding at 100 ppm in the diet) resulting in an anticipated maximum residue from feeding vegetables at 100% of the diet of $8 \times 0.0001 = 0.0008$ mg/kg, less than the relevant Australian, proposed Codex and likely regulatory method LOQ.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Pirimicarb

- is a carbamate aphicide used for the control of aphids in various crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (weeks)
<i>Artichokes</i>	25 g ai/hL	2	-
<i>Asparagus</i>	25 g ai/hL	2	-
<i>Beetroot</i>	0.5	2	-
<i>Beans</i>	0.25	2	-
<i>Brassica vegetables</i>	0.5	2	-
<i>Capsicums</i>	0.5	2	-
<i>Cucurbits</i>	0.5	2	-
<i>Kiwano</i>	0.5	2	-
<i>Leeks</i>	25 g ai/hL	2	-
<i>Lettuce</i>	0.5	2	-
<i>Okra</i>	25 g ai/hL	2	-
<i>Peas</i>	0.5	2	-
<i>Potatoes</i>	0.5	2	-
<i>Radishes</i>	0.5	2	-
<i>Spinach, shallots</i>	25 g ai/hL	2	-
<i>Swedes, turnips</i>	0.5	2	-
<i>Tomatoes</i>	0.5	2	-
<i>Watercress</i>	25 g ai/hL	2	-

There are Australian and Codex but no USA MRLs for pirimicarb in animal commodities. The Australian and Codex MRLs for meat and milk are all set at *0.1 mg/kg. As the MRLs are set at the limit of analytical quantitation and are essentially the same.

There are Australian MRLs of 7 mg/kg for leafy vegetables and 1 mg/kg for other vegetables. There is also a PAFC MRL of 20 ppm. In a feeding study reported by JMPR residues of pirimicarb were <0.05 mg/kg for animals dosed at the equivalent of 200 ppm in the diet, a level of exposure

¹⁰⁴ 2002 JMPR. Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

much greater than would be anticipated to arise from vegetable waste¹⁰⁵. The TF for milk is 0.00065 indicating a little likelihood that residues would be detected in milk.

It is anticipated that animal product residues will be below typical method LOQs.

Prochloraz

-is an imidazole fungicide used for the control of Anthracnose in *lettuce*. The application rate is 185 g ai/ha.

The harvest WHP is 7 days.

Do not feed treated crop to livestock or allow livestock to graze treated areas.

There are Codex but no Australian or US MRLs for prochloraz in animal commodities. The Codex MRLs are 10 mg/kg for cattle edible offal, 0.5 mg/kg for cattle fat and *0.05 mg/kg for milk. The Australian MRL for lettuce is 2 mg/kg.

The 1990 JMPR reported a feeding study in which cattle were dosed at rates of 10, 30 and 100 ppm for 28 days¹⁰⁶. At the lowest dose level, residues of 2.8, <0.05, 0.5 and 0.1-0.2 mg/kg, respectively, were found in liver, muscle, kidney and fat.

Livestock residues may exceed international and/or domestic market standards.

Procymidone

-is a dicarboximide fungicide used on crops for control of various fungal diseases.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Green beans</i>	0.75	-	-
<i>Green beans (post-harvest dip)</i>	500 ppm	-	-
<i>Onions</i>	2	28	-
<i>Lettuce</i>	1.0	2	-
<i>Tomatoes</i>	0.6	2	-
<i>Potatoes</i>	0.5	7	-
<i>Cucurbits</i>	0.5	2	-

There are Australian but no Codex or US MRLs for procymidone in animal tissues. The Australian MRLs are T0.2 mg/kg for fat, T0.05 mg/kg for offal and T0.02 mg/kg for milk.

The Australian MRL for beans is T10 mg/kg, peppers T2 mg/kg, onion T0.2 mg/kg, potato T1 mg/kg, and tomato 2 mg/kg.

The Australian animal commodity MRLs were based on a dietary burden of 10 ppm (APVMA gazette, APVMA Gazette, 13th July 2004 procymidone/lentils).

Insufficient data were located to provide confident opinion on livestock residue risks.

¹⁰⁵ 1978 JMPR - Pesticide Residues in Food - 1978 Evaluations, FAO Plant Production and Protection Paper 15 Suppl. FAO and WHO 1979

¹⁰⁶ 1990 JMPR. Pesticide Residues in Food - 1990 Evaluations, Part I Residues FAO Plant Production and Protection Paper 103/1. FAO and WHO 1990

Prometryn

- is a triazine herbicide used for the control of certain grasses in crops such as canola, cotton, sunflower, legumes and pastures. The application rate is up to 1.65 kg ai/ha pre-emergent or soon after crop emergence on *carrots*, *celery* and *potatoes*.

No harvest WHP required.

Do not graze or cut for stock food for 9 weeks after application

There are Australian but no Codex or US animal commodity MRLs for prometryn. The Australian MRLs are all set at *0.05 mg/kg. The Australian MRL for vegetables has been set at *0.1 mg/kg. There is an Australian MRL for hay and fodder of grasses (dry) of 50 ppm.

The US EPA considered that there is no reasonable expectation of detectable residues (US EPA refer to a feeding study conducted at 50 ppm)¹⁰⁷.

It is anticipated that animal product residues will be below typical method LOQs.

Propachlor

-is a herbicide used for the control of certain grasses and broad-leaved weeds in *swede*, *turnip* and *radish* crops. The application rate is 3.36 kg ai/ha. Propachlor is also registered for use on beetroot (1.82 kg ai/ha) and Brassica vegetables (7.2 kg ai/ha) as a pre-emergent/early post-transplant herbicide.

A harvest WHP is not required.

There are Australian but no Codex or US MRLs for propachlor in animal commodities. The Australian MRLs are 0.1 mg/kg for edible offal and *0.02 mg/kg for other commodities including milk. The Australian MRLs for radish and swede have been set at 0.02 mg/kg. The Australian MRLs for propachlor residues in beetroot and brassicas are *0.05 mg/kg and 0.6 mg/kg, respectively.

In an animal transfer study, dairy cattle were fed propachlor metabolites at rates of up to 50 ppm for 28 days, residues were detected in kidney (target tissue), liver, muscle, fat and milk¹⁰⁸. A transfer factor of 0.01 was calculated for kidney.

It is anticipated that animal product residues will be below typical method LOQs.

Propargite

- is an acaricide used for the control of mites in various crops. The application rate for *vegetables* is up to 30 g ai/hL. Propargite residues decline with typical half-lives of 56 and 5 days for soil and foliage respectively.

The harvest WHP is 7 days.

There are Australian, Codex and US MRLs for propargite in animal commodities. The MRLs applicable to cattle fat (target tissue) have all been set at *0.1 (US 0.1) mg/kg. The US MRL for

¹⁰⁷ Reregistration Eligibility Decision Prometryn List A Case 0467, Environmental Protection Agency, Office Of Pesticide Programs, Special Review And Reregistration Division, EPA 738-R-95-033 February 1996

¹⁰⁸ Reregistration Eligibility Decision, Propachlor List A Case 0177, Environmental Protection Agency, Office Of Pesticide Programs, Special Review And Reregistration Division, EPA 738-R-015 November 1998

milk fat is 2 mg/kg (0.08 mg/kg for whole milk). The Australian MRL for milk is *0.1 mg/kg while the Codex MRL is also *0.1 F mg/kg. There is an Australian MRL of 3 mg/kg for vegetables.

The TF for cattle fat (50 ppm feeding study) was 0.004¹⁰⁹ giving an anticipated residue in fat from feeding vegetable waste at 100% of the diet of *ca.* $3 \times 0.004 = 0.012$ mg/kg, less than the relevant international MRLs. The TF for milk (50 ppm feeding study) was 0.0002 giving an anticipated residue in fat from feeding vegetable waste at 100% of the diet of $3 \times 0.0002 = 0.0006$ mg/kg, less than the relevant international MRLs.

Note, from JMPR reports it is expected that residues in potatoes and potato peel (dry) will be <0.05 mg/kg. The 1978 JMPR reported residues in maize stover of 4 ppm at 47-105 days after application at 1.9 kg ai/ha and 2.4 ppm in silage.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Propineb

- is a propylenethiourea fungicide used on a variety of crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Celery</i>	1.4	7	-
<i>Cucurbits</i>	1.4	3	-
<i>Lettuce</i>	1.4	3	-
<i>Onions</i>	1.4	14	-
<i>Potatoes</i>	1.4	1	-
<i>Tomatoes</i>	1.4	3	-

There are Australian and Codex but no US MRLs for propineb (Codex as dithiocarbamates) in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The Australian PAFC MRL is 50 ppm, celery 5 mg/kg, cucurbits 2 mg/kg, leafy vegetables 5 mg/kg, bulb vegetables T10 mg/kg, potatoes 1 mg/kg and tree tomatoes T5 mg/kg.

Residues in vegetable waste would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb) was 0.003¹¹⁰ giving an anticipated maximum residue from the feeding of vegetable waste at 100% of the diet of $50 \times 0.003 = 0.15$ mg/kg, less than the relevant international MRLs for dithiocarbamates.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Propyzamide (pronamide)

-is an amide herbicide used for the control of certain broad-leafed weeds and grasses in *lettuce*.

Application is made at seeding at 2.25 kg ai/ha.

No harvest WHP is required.

Do not graze sheep on treated areas or feed treated produce to pigs or poultry.

¹⁰⁹ Pesticide Residues in Food - 2002 Evaluations – Part I: Residues Volume 1, FAO Plant Production and Protection Paper 175/1. FAO and WHO 2003

¹¹⁰ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

There are Australian and US but no Codex tolerances for propyzamide in animal commodities. The Australian and US residue definitions differ. The Australian residue definition is parent compound with MRLs of *0.2 for cattle edible offal, *0.05 mg/kg for cattle meat and *0.01 mg/kg for milk. The US residue definition is for the combined residues of propyzamide and its metabolites (containing the 3,5-dichlorobenzoyl moiety and calculated as 3,5-dichloro-N-(1,1-dimethyl-2-ropynyl)benzamide). The US MRLs are 0.4 mg/kg for kidney and liver and 0.02 mg/kg for other offal, meat and milk.

The Australian MRL for lettuce is 1 mg/kg.

In an animal transfer study where dairy cattle were fed propyzamide in the diet at rates of up to 40 ppm, residues were detected in liver (target tissue), kidney, muscle and milk¹¹¹. A transfer factor of 0.04 was calculated for liver.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Prothiofos

is an organophosphate insecticide used on *Brassica vegetables* for the control of cabbage moth, cabbage white butterfly etc. The application rate is 0.75 kg ai/ha. The harvest WHP is 7 days.

There are no Australian, Codex or US MRLs for prothiofos in animal tissues. The Australian MRL for Brassica vegetables is 0.2 mg/kg. The log P_{ow} for prothiofos is reported to be 5.67 suggesting residues may accumulate in fat.

Insufficient data were located to provide confident opinion on livestock residue risks.

Pymetrozine

-is an insecticide used to control aphids in *Brassica vegetables* and *potatoes*. It is also used to control silver leaf white fly on *tomatoes*, *egg plant*, *head lettuce*, *cucurbits* and *broccoli*. The application rate is 0.1 kg ai/ha.

The harvest WHP is 14 days for Brassica vegetables and not required for potatoes.

The harvest WHP for cucurbits, tomatoes and egg plants is 3 days.

The harvest WHP for broccoli is 5 days and head lettuce 7 days.

There are Australian but no Codex or US MRLs for pymetrozine in animal commodities. The Australian MRLs have all been set at *0.01 mg/kg. The Australia MRLs for Brassica vegetables and potatoes are *0.02 mg/kg, egg plant T0.05 mg/kg, tomatoes T0.2 mg/kg and cucurbits T0.1 mg/kg.

The US EPA reported¹¹² that no detectable residues of pymetrozine or CGA-313124 were observed in samples of liver, kidney, perirenal fat, omental fat, round muscle, or tenderloin muscle from cows dosed with 10 ppm pymetrozine. The US EPA used these results to establish that there was no need to establish meat and milk tolerances.

It is anticipated that animal product residues will be below typical method LOQs.

¹¹¹ Reregistration Eligibility Decision (RED) Pronamide List A Case 0082, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

¹¹² Pymetrozine Pesticide Tolerance Filing 9/98, Federal Register: October 7, 1998, Volume 63, Number 194, Page 53902-53911

Pyraclostrobin

-is a strobilurin fungicide used for the control of white blister rust in brassica leafy vegetables (APVMA permit). Application is at up to 125 g ai/ha. The WHP is 3 days for harvest.

There are Australian, US and Codex MRLs for pyraclostrobin in animal commodities. The Australian MRLs are *0.05 mg/kg for animal commodities except milk for which the MRL is *0.01 mg/kg. The Codex MRLs for edible offal, meat (fat) and milk are *0.05, 0.5 and 0.03 mg/kg respectively. The US MRLs are 1.5 mg/kg for liver, 0.2 mg/kg for other meat by-products, 0.1 mg/kg for meat, fat and milk. The Australian MRLs are : brassica leafy vegetables T3 mg/kg and for broccoli, Chinese T1 mg/kg..

The APVMA PRS noted¹¹³:

Lactating dairy cows were fed pyraclostrobin in the diet for 28 consecutive days at levels equivalent to 8.8, 27.2 and 89.6 ppm in the diet. Residues of the parent compound were <LOQ (<0.01 or <0.05 mg/kg) in whole milk, skim milk, muscle, fat, kidney and liver of cows from all dose groups. Finite residues of the parent compound (0.016-0.044 mg/kg) were only observed in cream of cows dosed at the 89.6 ppm level. Total residues of pyraclostrobin and metabolites convertible to the chlorophenylpyrazole and 2-hydroxychloropyrazole analytical targets were <LOQ (<0.1 mg/kg) in muscle and fat at all feed levels. Finite residues were observed in liver at all dose levels and kidney at the highest dose level only. Total residues in liver were <0.1-0.32 mg/kg, 0.46-0.61 mg/kg and 2.1-2.8 mg/kg for the 8.8 ppm, 27.2 ppm and 89.6 ppm dose groups respectively. Total residues in kidney were 0.37-0.40 mg/kg for the 89.6 ppm dose group and <0.1 mg/kg for the lower dose groups. In the highest dose group the total residues in milk plateaued within 7 days of dosing. Total residues in milk were all <LOQ (<0.02 mg/kg) for the 8.8 ppm dose group. Total residues in milk peaked at 0.024 mg/kg and 0.18 mg/kg for the 27.2 ppm and 89.6 ppm dose groups respectively. Total residues in cream were 0.021-0.33 mg/kg, <0.02-0.056 mg/kg and 0.13-0.26 mg/kg for the 8.8 ppm, 27.2 ppm and 89.6 ppm dose groups respectively. In skim milk finite residues were only observed in the 89.6 ppm dose group at 0.039-0.10 mg/kg. The results of the dairy cow transfer study are in contrast to those observed in the goat metabolism study, particularly in relation residues observed in fat. The residues of parent compound are compared in the following table:

Study	¹⁴ C label position	Dose, ppm in feed (mg/kg bw)	Pyraclostrobin in fat, mg equiv./kg or mg/kg
Goat	Chlorophenyl	12.23 (0.95)	0.069
	Chlorophenyl	78.13 (2.72)	0.819
	Tolyl	12.19 (0.7)	0.061
	Tolyl	69.86 (1.37)	0.318
Cow	-	8.8 (0.22)	<0.05
	-	27.2 (0.67)	<0.05
	-	89.6 (2.40)	<0.05

The goat study indicates significant fat solubility of the parent compound, however, residues >0.05 mg/kg were not reported in cow fat, even at the highest dose level. The goat metabolism study is therefore used as a conservative estimate of potential residues in mammalian fat.

Sample	Observed HR, mg/kg	Study feed level, ppm	Expected residue 1, mg/kg, from stated dietary exposure	
			0.28 ppm in diet 2	4.65 ppm in diet 3
Liver	0.32	8.8	<0.1	0.17
Kidney	<0.1	8.8	<0.1	<0.1
Milk	<0.02	8.8	<0.02	<0.02

¹¹³ Public Release Summary on Evaluation of the new active PYRACLOSTROBIN in the product CABRIO FUNGICIDE Australian Pesticides and Veterinary Medicines Authority September 2003 Canberra Australia

Cream	0.033	8.8	<0.02	<0.02
Muscle	<0.1	8.8	<0.1	<0.1
Fat	0.819	78.1	<0.05	<0.05

1. Estimated residue in fat is for parent compound only based on goat metabolism study. Residues in other tissues are based on the cow transfer study and are expressed as pyraclostrobin following analysis by the common moiety method.
2. Assumes grape pomace containing pyraclostrobin at the STMR consumed at 20% of the diet
3. Assumes grape pomace containing pyraclostrobin at the HR consumed at 50% of the diet

No residues are expected in animal tissues or milk from animals exposed to levels in the diet from feeding waste from brassica vegetables.

It is anticipated that animal product residues will be below typical method LOQs.

Pyrazophos

-is a phosphorothiolate fungicide used for the control of powdery mildew on *cucurbits*. The application rate is ca. 0.15 kg ai/ha.
The harvest WHP is 1 day.

There are no Australian, Codex or US MRLs for pyrazophos in animal commodities. The Australian MRL for cucumbers is T2 mg/kg.

A metabolism study with lactating goats was reported by the 1987 JMPR suggesting residues on feeding cucumber would not be detected in animal tissues. The log P_{ow} for pyrazophos is 3.8.

It is anticipated that animal product residues will be below typical method LOQs.

Pyrethrins

- is a natural pyrethroid insecticide used for the control various insect pests in *vegetables*. The application rate is up to 7.5 g ai/hL.
The harvest WHP is 1 days.

There are US but no Australian or Codex MRLs for pyrethrins in animal commodities. The MRLs applicable to cattle fat are 1 and other tissues 0.05 mg/kg. The MRL for milk fat is 0.05 mg/kg reflecting negligible residues in whole milk. There is an Australian MRL of 1 mg/kg for vegetables.

The JMPR reported a PF for tomatoes to tomato pomace (dry) of 29. In a feeding study with lactating cows, residues in tissues of animals dosed orally at a level equivalent to 5 ppm in the feed had residues in tissues that were <LOQ (0.038 mg/kg) for muscle, liver and kidney and 0.048-0.075 mg/kg in fat¹¹⁴. TF for fat = 0.015. Feeding vegetables and waste with residues of 1 ppm should not result in tissues residues above typical LOQs for pyrethrins. Feeding tomato pomace with residues of $29 \times 1 = 29$ mg/kg at 30% of the diet would give rise to residues in fat of $0.3 \times 29 \times 0.015 = 0.13$ mg/kg. A value of $1/3^{rd}$ of this to account for the dilution of residues with tomatoes from a variety of sources would be a more appropriate.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Pyrimethanil

-is a fungicide used for the control of target spot (early blight) in *tomatoes* and *potatoes*. It is applied as a foliar spray at an application rate of 0.3 kg ai/ha.

¹¹⁴ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

The harvest WHP is 1 day for tomatoes and not required for potatoes.
Do not graze treated area or cut for stock food

There are Australian and US but no Codex MRLs for animal tissues. The Australian MRLs for animal commodities are *0.05 mg/kg for tissues and *0.01 mg/kg for milks. The US MRL for kidney is 2.5 while other tissues of animal is set at 0.01 mg/kg. The Australian MRL for potatoes is *0.01 mg/kg and that for tomatoes T5 mg/kg.

The US EPA reported that in a metabolism study, cows were dosed at a rate equivalent to 250 ppm in the feed for 7 days. Maximum TRRs of 0.36 mg equiv./kg were observed in fat and liver.

In a 1993 lactating dairy cow metabolism study, a cow received 7 daily doses of anilino-labelled ¹⁴C-pyrimethanil at a dose rate equivalent to 10 ppm¹¹⁵. The cow was sacrificed with 24 hours of the last dose. TRR residues in milk (as parent) reached a plateau after 2 days of 0.05-0.06 mg/L (highest 0.069 mg/L at day 5). The metabolite SN 614276 represented 64% of the TRR in milk. TRR in tissues were 0.017 for muscle, 0.036 for fat, 0.25 for kidney and 0.36 mg equiv/kg for liver. Two major metabolites were identified in kidney: SN614276 (46% TRR) and SN 614800 (7% TRR). For muscle and fat, 53 and 77% respectively of the TRR was organo-extractable. For liver 73% of the TRR remained un-extracted. Feeding liver to rats did not result in detectable ¹⁴C residues and it was concluded that liver residues were unlikely to be bio-available.

Given that pyrimethanil is known to undergo extensive metabolism in animals, it is concluded that feeding of treated tomato pomace to animals (even if residues concentrate in pomace) is not expected to give rise to detectable levels of pyrimethanil residues in animal commodities.

It is anticipated that animal product residues will be below typical method LOQs.

Pyriproxyfen

-is an insect growth regulator used for silverleaf whitefly control on cucurbits, egg plants and tomatoes. The application rate is up to 50 g ai/hL.
The harvest WHP is 1 day.

The Australian MRLs for animal commodities are all *0.02 mg/kg including milk. The MRL for fruiting vegetables other than cucurbits is 1 mg/kg and for cucurbits 0.2 mg/kg.

The JMPR reported animal feeding studies¹¹⁶. Groups of 3 lactating dairy cows (each weighing 400-620 kg and producing approximately 15 kg milk per day) were dosed with pyriproxyfen at 0.13, 0.38 or 1.17 mg/kg bw/day, equivalent to nominal feed levels of 3, 9 and 30 ppm in the diet on a dry weight basis for 28 days. Milk samples up to day 14 from the 3 and 9 ppm feeding groups did not contain detectable residues. Residues of pyriproxyfen, but not the metabolites, were detected in the cream of milk from the 30 ppm group taken on day 24, implying that pyriproxyfen is fat-soluble. Pyriproxyfen was not detected (<0.01 mg/kg) in the cream of milk from the 9 ppm group taken on day 24. In the tissues pyriproxyfen itself was detected only in the fat, again confirming its classification as a fat-soluble compound. Mean residues of 0.058 mg/kg in the 30 ppm group and 0.018 mg/kg in the 9 ppm group suggested that residues would be proportional to the doses. Maximum residues in fat for the 30 ppm dose group were 0.072 mg/kg (TF 0.0024).

¹¹⁵ Evaluation of fully approved or provisionally approved products: Issue No. 138 pyrimethanil September 1995

¹¹⁶ 1999 JMPR - Pesticide Residues in Food - 1999 Evaluations, Part I Residues FAO Plant Production and Protection Paper 157. FAO and WHO 2000

It is anticipated that animal product residues will be below typical method LOQs.

Quintozene

-is a fungicide used to control soil borne diseases in vegetables. It is applied prior to, at planting or transplanting and thinning.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)	Harvest WHP (days)	Grazing WHP (days)
<i>Tomato</i>	0.375 kg ai/hL	28	See below
<i>Lettuce</i>	0.1125 kg ai/hL	28	“
<i>Beans</i>	16.5	28	“
<i>Potato</i>	33	28	“
<i>Cabbage, cauliflower, broccoli</i>	16.5	28	“

Do not graze treated area or cut for stock food.

There are no Australian, Codex or US MRLs for animal tissues. Australian MRLs for vegetables are 0.01 mg/kg for beans, 0.02 mg/kg for Brassica vegetables, 0.3 mg/kg for celery, 0.3 mg/kg for lettuce, 0.2 mg/kg for onions, 0.01 mg/kg for capsicums, 0.2 mg/kg for potatoes and 0.1 mg/kg for tomatoes.

A processing factor of *ca.* 8 for tomato pomace (wet) can be obtained from data reported by the 1998 JMPR. The TF for fat is *ca.* 0.005 (10 ppm feed level, residue as parent compound)¹¹⁷.

Assuming residues at the same level as the MRL, a processing factor of 8 and feeding at no more than 30% of the diet would give anticipated residues in fat of $0.3 \times 8 \times 0.1 \times 0.005 = 0.001$ mg/kg. (NOTE residues would still be <LOQ if corrected for tomato pomace to be on a dry weight basis)

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Quintozene can contain up to 100 mg/kg hexachlorobenzene (HCB), an application rate of 33 kg ai/ha (potatoes) corresponds to application of HCB at 3.3 g/ha. The half-life for HCB in soil is 3-6 years. Uptake of HCB by potatoes was such that the ratio of soil to crop residues ranges from 0.5 – 1.24 for tubers. The contribution from previous years applications (assumed 12 years of additions 1 spray per year at the maximum rate = 3.3 g HCB/ha = 72.6 g HCB/ha), distributed in the top 20 cm soil with density 1 g/mL would be $72600 \text{ mg} / 2000000 \text{ kg} = 0.036$ ppm. Residues in potatoes would account for no more than 0.045 ppm.

Feeding potato culls with residues of 0.045 ppm at 100% of the diet would give rise to residues of $0.045 \times 8 = 0.36$ mg/kg in fat and $0.045 \times 8.4 = 0.38$ mg/kg in milk fat. Potato culls are unlikely to be fed at more than 10% of the diet.

Livestock residues (HCB) are not anticipated to exceed international and/or domestic market standards.

Quizalofop ethyl

is a herbicide used for the control of various grass weeds in vegetable crops.

¹¹⁷ 1995 JMPR - Pesticide Residues in Food - 1995 Evaluations, Part I Residues FAO Plant Production and Protection Paper 137. FAO and WHO 1996

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)	Harvest WHP (days)	Grazing WHP (days)
Beetroot	100	14 days	-
Cabbage	100	9 weeks	-
Cauliflower	100	14 days	-
Carrots	100	10 weeks	-
Cucumbers	100	14 days	-
Green beans	100	5 weeks	28 days
Honey dew melons	100	9 weeks	-
Onions	100	18 weeks	-
Potatoes	100	10 weeks	-
Pumpkins	100	9 weeks	-
Radish	100	21 days	-
Tomatoes	100	4 weeks	-

There are Australian and US but no Codex MRLs for animal commodities. The Australian MRL for meat (mammalian) has been set at *0.02 mg/kg and for edible offal (mammalian) 0.2 mg/kg. The US MRLs are 0.05 mg/kg for fat and meat by-products and 0.02 mg/kg for meat. The US MRL for milk is 0.01 mg/kg and for milk fat 0.25 mg/kg. The US residue definition is the sum of quizalofop-ethyl, quizalofop- methyl and quizalofop expressed as quizalofop ethyl. The Australian MRLs for vegetables are 0.02 mg/kg for beetroot, *0.01 mg/kg for head cabbage, *0.02 mg/kg for carrot, *0.05 mg/kg for cauliflower, *0.02 mg/kg for beans, *0.02 mg/kg for cucurbits, *0.02 mg/kg for onions, *0.01 mg/kg for potatoes, *0.02 mg/kg for radish and *0.02 mg/kg for tomatoes. There is also an animal feed MRL of 10 ppm for forage and fodder of green beans.

In a feeding study¹¹⁸, three groups of lactating dairy cows were fed 0.1, 0.5, and 5.0 ppm quizalofop ethyl ester (encapsulated) for 28- consecutive days. Two cows were sacrificed after 28 days with samples of fat, skeletal muscle, liver, and kidney being collected and analysed. The remaining cow in each test group was fed a regular diet without encapsulated quizalofop ethyl ester for an additional 7 days before sacrifice. Whole milk, skim milk, and cream from the control, and the 0.1 and 0.5 ppm dose groups showed no quizalofop to < 0.02 ppm (0.05 ppm in cream). From the 5 ppm dose, quizalofop residues ranged from 0.01 to 0.02 ppm in whole, and when these samples were separated into cream and skim milk, the quizalofop partitioned into the cream with residues plateauing at 0.26 to 0.31 ppm. No quizalofop to < 0.02 ppm was detected in skeletal muscle, and to < 0.05 ppm was detected in any liver or fat sample from any of the three doses. Quizalofop was detected in one kidney sample as 0.05 ppm from the 5 ppm dose. TF kidney = 0.01.

Feeding green bean forage and fodder with residues of 10 ppm at 100% of the diet would give rise to residues in kidney of $10 \times 0.01 = 0.1$ mg/kg. Anticipated residues in milk are $10 \times 0.004 = 0.04$ mg/kg and in cream $10 \times 0.06 = 0.6$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Rimsulfuron

-is a sulfonylurea herbicide used for the control of certain broadleaf weeds in *tomatoes*. The application rate is 15 g ai/ha.

¹¹⁸ US EPA ([Federal Register: August 25, 2004 (Volume 69, Number 164)] [Notices] [Page 52256-52261] ENVIRONMENTAL PROTECTION AGENCY [OPP-2004-0245; FRL-7372-4] Quizalofop-Ethyl; Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food)

The harvest WHP is 4 weeks.

Do not graze or cut for stock food for 6 weeks after application.

There are no Australian, Codex or US MRLs for rimsulfuron in animal commodities. The Australian MRL for tomatoes is *0.05 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

Sethoxydim

- is a cyclohexanedione herbicide used for the control of certain grass weeds in crops.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (kg ai/ha)*	Harvest WHP (days)	Grazing WHP (days)
<i>Asparagus</i>	0.19	1 day	-
<i>Brassica vegetables, green beans, Swedes, tomatoes</i>	0.19	6 weeks	-
<i>Cucurbits, red beet, lettuce, onions</i>	0.19	4 weeks	-
<i>Carrots, potatoes, sweet potatoes</i>	0.19	-	-
<i>Green peas</i>	0.19	10 weeks	-

*higher rates may be permitted in Tasmania

There are Australian and US MRLs for sethoxydim but no Codex MRLs. However, the Codex residue definition for clethodim is the “sum of clethodim and its metabolites containing 5-(2-ethylthiopropyl)cyclohexene-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexene-3-one moieties and their sulphoxides and sulphones, expressed as clethodim”. Comparison with the Australian residue definition indicates residues for sethoxydim will be covered by Codex MRLs for clethodim. The Codex MRLs for clethodim are *0.2 mg/kg for edible offal and meat and *0.05 mg/kg for milk. The Australian residue definition is sethoxydim and its metabolites containing 5-(2-ethylthiopropyl)cyclohexane-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexene-3-one moieties and their sulphoxides and sulphones, expressed as sethoxydim. The US residue definition is sethoxydim and its metabolites containing the 2-cyclohexen-1-one moiety. The Australian MRLs for animal commodities have been set at *0.05 mg/kg. The US MRLs for cattle tissues are 1 mg/kg for meat by-products, 0.2 mg/kg for other tissues while the milk MRL is 0.5 mg/kg.

The USA also has tolerances for several major animal feeds including alfalfa forage and hay (40 ppm), bean hay and clover hay (50 ppm). The tolerances suggest that sethoxydim may be fed at up to 50 ppm in the diet without exceeding the USA animal commodity MRLs. The Australian vegetable MRLs are 1 mg/kg for asparagus, *0.1 mg/kg for beans, 0.5 mg/kg for Brassica vegetables, *0.1 mg/kg for cucurbits, 0.2 mg/kg for lettuce, 0.3 mg/kg for onions, 1 mg/kg for root and tuber vegetables (eg potatoes) and 0.1 mg/kg for tomatoes.

It is anticipated that animal product residues will be below typical method LOQs.

Simazine

- is a triazine herbicide used for the control of weeds in vegetable crops. It is used on *asparagus* crops at 2.25 kg ai/ha with application before spear emergence.

No harvest WHP is required.

There are Australian and US but no Codex MRLS for animal commodities. The Australian MRLs have all been set at *0.05 mg/kg except milk which is *0.02 mg/kg. The US MRLs are 0.3 mg/kg for animal commodity..

The Australian MRL for asparagus is *0.1 mg/kg.

It is anticipated that animal product residues will be below typical method LOQs.

S-metolachlor

see metolachlor

Spinosad

- is an antibiotic insecticide used for the control of heliothis and various other pests in vegetable crops. The application rate is up to 96 g ai/ha.

The application rates for vegetables are reported in the table below together with the harvest WHPs and any label feeding restraints.

Crop	Rate (g ai/ha)*	Harvest WHP (days)	Grazing WHP (days)
<i>Brassica vegetables</i>	96	3	See below*
<i>Peppers, capsicums</i>	96	3	See below*
<i>Tomatoes</i>	96	1	See below*
<i>Lettuce, spinach</i>	96	3	See below*
<i>Sweet corn</i>	96	-	28
<i>Beans, except broad and soya beans</i>	96	3	14
<i>Peas</i>	96	3	14
<i>Potatoes</i>	96	3	See below*

*Do not allow livestock to graze crops, stubble or waste that has been treated with spinosad.

There are Australian, Codex and USA MRLs for spinosad in animal commodities. The Australian and US MRLs applicable to cattle meat (fat) are 2 and 50 mg/kg respectively. The respective milk MRLs are 0.1 and 7 (85 mg/kg for whole milk fat) mg/kg. The Codex MRL is 3 mg/kg for cattle fat and 2 mg/kg for fat of other mammals and 1 mg/kg for cattle milk (5 mg/kg for milk fat). There are Australian MRLs of 0.5 mg/kg for Brassica vegetables, 5 mg/kg for leafy vegetables, beans and peas 0.5 mg/kg, 0.02 mg/kg for sweet corn (corn-on-the-cob) and 0.02 mg/kg for root and tuber vegetables. The MRL for sweet corn fodder and forage (dry) is 1 ppm.

The TF for cattle fat is 0.5-0.6¹¹⁹. The 2001 JMPR reported a PF for tomatoes to tomato pomace (dry) of 15. Assuming pomace is fed at a maximum of 30% of the diet, residues in the treated crop are at the same level as the MRL and a PF of 15 for fresh tomatoes to pomace (dry) anticipated residues in fat are $0.3 \times 15 \times 0.2 \times 0.6 = 0.5$ mg/kg.

The TF for milk is 0.05 giving an anticipated maximum residue in cattle milk from feeding of pomace at 30% of the diet of $0.3 \times 15 \times 0.2 \times 0.05 = 0.045$ mg/kg.

The JMPR also reported the residues in sweet corn forage and fodder (stover) following multiple applications at 100 g ai/ha and harvest at 7 (forage) or 28 (fodder) days after the last application. Residues in forage were 0.07-0.49 ppm while residues in fodder were 0.03-0.68 ppm. If these residues are assumed to reflect likely residues in forage/fodder, anticipated residues from feeding

¹¹⁹ 2001 JMPR Pesticide Residues in Food - 2001 Evaluations – Part I, FAO Plant Production and Protection Paper 171. FAO and WHO 2002

sweet corn forage/fodder/trash at 100% of the diet are $0.68 \times 0.6 = 0.41$ mg/kg in fat and $0.68 \times 0.05 = 0.034$ mg/kg in milk.

The half-life for the decline of residues in fat is of the order of 7 days.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Spirotetramat

- is an insecticide used for the control of various pests in vegetable. The application rate is up to 96 g ai/ha.

Crop	Rate	WHP
Brassica vegetables (including broccoli, brocolini, Brussels sprouts, cabbage, cauliflower, Kohlrabi)	96 g ai/ha	3 days
Brassica leafy vegetables (including Buk choy, Chinese broccoli, Chinese cabbage, Choy sum, Gai choy/Am soy, Kai choy, Kale, Mibuna, Leafy mustard Indian mustard and mustard spinach (Komatsuma), Pak choy, tat soy)	96 g ai/ha	3
Onions	48 g ai/ha	7
Leafy vegetables (including cress, endive, silverbeet, spinach but NOT lettuce)	48 g ai/ha	3
Lettuce, chicory, endive	48 g ai/ha	1 lettuce, 3 endive, chicory
Fruiting vegetables (capsicum, eggplant, peppers, tomato but excluding cucurbits)	96 g ai/ha	1
Cucurbits (cucumbers, melons, pumpkins, squash, zucchini)	96 g ai/ha	1
Potatoes, sweet potatoes	96 g ai/ha	7

Do not graze treated brassica or chicory crops

There are Australian, Codex and USA MRLs for spirotetramat in animal commodities. The Australian MRLs are edible offal 0.05 mg/kg, meat *0.01 mg/kg and milks *0.005 mg/kg. The Codex MRLs are edible offal 0.03 mg/kg, meat *0.01 mg/kg and milks *0.005 mg/kg while the US tolerances are 0.02 mg/kg for tissues and 0.01 mg/kg for milk. There are Australian MRLs of brassica (cole or cabbage) vegetables, head cabbages, flowerhead brassicas [except Brussels sprouts] 7mg/kg, Brussels sprouts 1 mg/kg, fruiting vegetables, cucurbits [except melons] 2 mg/kg, fruiting vegetables, other than cucurbits 7 mg/kg, leafy vegetables (except lettuce, head) 5 mg/kg, melons, except watermelon 0.5 mg/kg, onion, bulb 0.5 mg/kg, potato 5 mg/kg, sweet Potato 5 mg/kg and watermelon 0.5 mg/kg.

The 2008 JMPR reported feeding studies where lactating cows were dosed for 28 days. At the 3 ppm feeding level, each analyte was below the LOD in all tissues except kidney. For kidney, spirotetramat enol was quantified at 0.019–0.024 mg/kg, average 0.021 mg/kg. At the 9 ppm feeding level, all analytes except spirotetramat enol were absent at the LOD in all tissues. Spirotetramat enol was measured at 0.013 mg/kg in the fat of one of three animals, average 0.008 mg/kg. The metabolite was absent in muscle, but was found at levels of 0.049–0.10 mg/kg in kidney, average 0.094 mg/kg, and at levels of 0.009 (< LOQ)–0.014 mg/kg in liver, average 0.094 mg/kg.

At the 30 ppm feeding level, all analytes were absent in milk at the LOQ (0.005 mg/kg) except for spirotetramat enol at 0.005 mg/kg in one of three cows. Residues of spirotetramat and spirotetramat enol GA were below the LOD in all milk samples, except in one milk sample at 0.0008 mg/kg. Residues of parent equivalents did not concentrate in samples of skim milk or milk fat separated mechanically from whole milk. At the 30 ppm feeding level, spirotetramat enol was quantifiable in fat (< 0.005–0.032 mg/kg), muscle (0.0043–0.014 mg/kg), kidney (0.17–0.41 mg/kg), and liver (0.025–0.038 mg/kg). Additionally, spirotetramat enol GA was quantifiable in liver (maximum 0.018 mg/kg) and kidney (maximum 0.030 mg/kg).

Average residues (BYI08330+enol) were:

Dose level (ppm)	Fat	Muscle	Kidney	Liver	Milk

3	<0.02	<0.02	0.031	<0.02	<0.005
6	0.021	<0.02	0.081	0.023	<0.005
30	0.028	0.021	0.27	0.040	<0.005

Feeding of citrus pulp (dry) at 30% of the diet leads to an anticipated dietary burden of $0.3 \times 2 = 0.6$ ppm.

It is anticipated that animal product residues will be below typical method LOQs.

Tau-fluvalinate

-is a synthetic pyrethroid insecticide used on *cauliflower* and *tomatoes* for the control of insect pests including *helicoverpa*. Application is at 96 g ai/ha.

The harvest WHP is 2 days.

There are no Australian or Codex or US MRLs for animal tissues. The Australian MRL tomatoes and cauliflower is 0.5 mg/kg.

The TF for fluvalinate in fat is 0.05 (4.8 ppm feeding level)¹²⁰. Feeding culled vegetables with residues at the MRL of 0.5 ppm at 100% of the diet would give rise to residues of $0.5 \times 0.05 = 0.025$ mg/kg in fat. No information was located on residues in tomato processed animal feeds.

The mean TF for fluvalinate in milk is 0.02 (4.8 ppm feed level) resulting in an anticipated maximum residue from feeding culled vegetables of $0.5 \times 0.02 = 0.01$ mg/kg.

Livestock residues may exceed international and/or domestic market standards.

Tebuconazole

-is a DMI fungicide used for the control of rust in *beans* and powdery mildew in *peas* and in *lettuce* for *Scerotinia* rot. The application rate is 150 g ai/ha for green beans and lettuce and 62 g ai/ha for peas.

The harvest and grazing WHPs is 3 days for beans and peas and 8 weeks for lettuce.

There are Australian, Codex and US MRLs for tebuconazole in animal tissues. The Australian and Codex residue definition is tebuconazole while the USA residue definition is the sum of tebuconazole and its 1-(4-chlorophenyl)-4,4-dimethyl-3-(1H-1,2,4-triazole-1-yl-methyl)-pentane-3,5-diol metabolite. The Australian MRLs 0.5 mg/kg for edible offal mammalian, 0.1 mg/kg for meat (mammalian) and 0.05 mg/kg for milk. The Codex MRLs are *0.05 mg/kg for both cattle meat and cattle edible offal and *0.01 mg/kg for milk. The US MRLs are 0.2 mg/kg for meat byp and 0.1 mg/kg for milk.

The Australian MRL for legume vegetables is 0.5 mg/kg. The MRLs for lettuce are 0.1 mg/kg for head and leaf varieties. There is a PAFC MRL of 50 ppm.

Residues in forage following application at the Australian rate were <2 ppm in trials reported by JMPR. Residues of tebuconazole were not detected (<0.05 mg/kg) in muscle and fat of dairy cattle dosed at the equivalent of 250 ppm in the diet for 28 days¹²¹. The residues in liver were 0.2 mg/kg. The TF for liver is 0.0008.

¹²⁰ Evaluation of fully approved or provisionally approved products. Issue 162: Evaluation on Tau-fluvalinate, March 1997, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

¹²¹ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

It is anticipated that animal product residues will be below typical method LOQs.

Terbufos

-is a organophosphorous insecticide/nematicide used on sweet corn for the control of wireworm. Application is at rates up to 0.3 kg ai/ha. A WHP is not required.

There are Australian and Codex but no US MRLs for terbufos in animal commodities. The Australian and Codex MRLs are *0.05 mg/kg for cattle edible offal and cattle meat. The Australian and Codex MRLs for milk have been set at *0.01 mg/kg.

The Australian MRL for sweet corn (corn-on-the-cob) is *0.05 mg/kg. The animal feed MRLs are *0.05 mg/kg for forage of cereal grains and straw and fodder (dry) of cereal grains.

It is anticipated that animal product residues will be below typical method LOQs.

Terbutryn

- is a selective herbicide used for the control of broadleaf weeds in *canning peas* (Tasmania only). It is applied at a maximum application rate of 0.5 kg ai/ha. The harvest WHP is 4 weeks.

There are no Codex or US MRLs for terbutryn. The Australian MRLs for meat (mammalian) and milk are both 0.1 mg/kg while the MRL for edible offal is 3 mg/kg. Animal feed commodity MRLs of 30 ppm have been set for field pea fodder and forage.

The Australian MRL for peas is *0.1 mg/kg.

The APVMA Animal Residue Data Sheet (July 2003) notes that the Australian animal MRLs were based on a feeding and/or metabolism study where animals were dosed at the equivalent of 60 ppm in the diet.

Livestock residues may exceed international and/or domestic market standards, however insufficient data were located to provide confident opinion on livestock residue risks.

Tetradifon

-is a miticide used for the control of various mites on vegetables and fruit crops. The application rate is 0.2 kg ai/ha for *beans, capsicums, celery, cucumbers* and *tomatoes* with a 7 day harvest WHP.

There are no Australian MRLs for tetradifon residues in animal commodities. The USA has set nil tolerances for tetradifon residues in meat and milk. The Australian MRL for vegetables is 5 mg/kg.

On feeding cattle apple pomace with tetradifon residues in the range 0.07-0.53 ppm, residues after 160 days of feeding were 0.17 mg/kg in fat¹²². Assuming residues in vegetables are at the same level as the Australian MRL of 5 ppm, and the average residue in pomace in the feeding study was 0.3 ppm (range 0.07-0.53 ppm), gives an estimated residue in fat from feeding vegetables of 2.8 mg/kg (5 ppm × 0.17 mg/kg ÷ 0.3 ppm = 2.8 mg/kg. Estimated range = 1.6 – 12 mg/kg in fat).

¹²² Rumsey, T.S., Bovarel, K.P., Fontenot, J.P., Oltjen, R.R., & Priode, B.M. (1977) Supplementation of apple pomace with non-protein nitrogen for gestating beef cows. IV. Pesticide accumulation in cows. J. Anim. Sci., 46: 543-550

No information was located on the occurrence of tetradifon residues in bean forage/hay or tomato pomace. (Scaling anticipated residues in bean forage at day 0 of 88 ppm for application at 1 kg ai/ha gives a day 0 residue of 18 ppm).

Livestock residues may exceed international and/or domestic market standards.

Thiabendazole

- is a systemic fungicide used for the post-harvest control of storage diseases in *potatoes*. It is registered on potatoes as a post-harvest mist spray at an application rate of 45 g ai/tonne. Not required when used as directed.

There are Australian, Codex and US MRLs for thiabendazole in cattle tissues. The Australian MRL for animal tissues have been set at 0.2 mg/kg while the milk MRL is 0.05 mg/kg. There is an Australian MRL for apples at 10 mg/kg. The Codex MRL for cattle kidney is 1 mg/kg while the MRL for cattle milk is 0.2 mg/kg. The US MRLs for cattle meat and milk are 0.1 mg/kg.

The 1997 JMPR reported a PF of 17 for dried potato peel. If it is assumed residues in potatoes are at the same level as the MRL, residues in dried potato peel would be $17 \times 5 = 85$ ppm.

It is considered unlikely that treated potatoes would be fed to animals. The TF for kidney (target tissue) is 0.004¹²³ giving anticipated residues of $0.3 \times 5 \times 0.004 = 0.006$ mg/kg if fed treated potatoes at 30% diet, below the Australian, Codex and US tolerances. If fed peel from treated potatoes at 30% of the diet the residues would be $0.3 \times 85 \times 0.004 = 0.1$ mg/kg.

The TF for milk is 0.001 giving anticipated residues of $0.3 \times 5 \times 0.001 = 0.0015$ mg/kg and $0.3 \times 85 \times 0.001 = 0.0255$ mg/kg respectively for potatoes and potato peel if fed at 30% diet.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Thiamethoxam

- is a nitroguanidine insecticide used as a seed dressing for the control of wireworms in *sweet corn*. The application rate is up to 0.49 g ai/1000 seeds. No harvest WHP required as is a seed dressing.

There are Australian and USA but no Codex MRLs for thiamethoxam in animal commodities. The Australian MRLs are all *0.02 mg/kg except milk which is *0.005 mg/kg. The US MRLs applicable to cattle commodities are 0.02 mg/kg for meat and milk and 0.04 mg/kg for meat byproducts. There are Australian MRLs of *0.02 mg/kg for sweet corn (corn-on-the-cob).

The US EPA reported¹²⁴ trials where thiamethoxam was used as a seed treatment for corn. Seed was treated at rates of 100 to 450 g thiamethoxam per 100 kilograms of seed. Thirty-six field trials were conducted in 19 states representing typical corn growing areas of the United States, including 21 field corn, 12 sweet corn, and 3 popcorn field trials. There were no detectable residues (<0.01 ppm) of either thiamethoxam or the major metabolite in any grain, ear or field corn processed fraction. The maximum residues in animal feed commodities were 0.09 ppm in forage and 0.03 ppm in stover (total thiamethoxam equivalents).

¹²³ 2000 JMPR. Pesticide Residues in Food - 2000 Evaluations – Part I, FAO Plant Production and Protection Paper 165. FAO and WHO 2001

¹²⁴ US EPA Thiamethoxam Pesticide Petition Filing 6/02 ENVIRONMENTAL PROTECTION AGENCY [OPP-2002-0115; FRL-7183-2] Notice of Filing a Pesticide Petition to Establish a Tolerance for a Certain Pesticide Chemical in or on Food. AGENCY: Environmental Protection Agency (EPA). ACTION: Notice.

Metabolism studies in animals demonstrated that parent thiamethoxam was a major residue in all tissues, with the exception of liver¹²⁵. A dose level equivalent to 100 ppm in the feed was used in these studies. For animal feed commodities, an MRL of 0.5 ppm was recommended for dry straw, forage, fodder and trash of maize, sweet corn, sorghum and cotton. If we assume that treated produce contains residues at the MRL of 0.5 ppm and comprises 100% of the animal diet, then scaling the residue results from the metabolism study (goats) gives an estimate of the likely residues in tissues from normal feeding of treated produce. Anticipated residues in muscle, fat, liver, kidney and milk are < 0.008 mg/kg. Parent compound is estimated in muscle, fat, kidney and milk at 0.0006, 0.0014, 0.008 and 0.002 mg/kg, respectively. These values are considered to be an overestimate of residues in tissues from consumption of treated produce. Residue trials provided for various crops demonstrated that thiamethoxam residues will be present below the analytical limit of quantitation in crop parts after the appropriate grazing / stock food restraints of 6 and 8 weeks for maize/corn and sorghum, respectively. The estimates of residues in tissue and milk are therefore considered to be conservative and much higher than would be expected from normal consumption of treated produce.

It is anticipated that animal product residues will be below typical method LOQs.

Thiodicarb

see methomyl

Thiram

- is a dithiocarbamate fungicide used on a variety of crops. It is used on *carrots*, *beans*, *cabbage* and *celery* for the control of Septoria leaf spot at an application rate of 120 g ai/hL and on *lettuce* for the control of anthracnose at a maximum application rate of 160 g ai/hL.

The harvest WHP is 7 days

Do not feed grass clipping from treated areas or treated seed to poultry or animals

There are Australian and Codex but no US MRLs for thiram in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂.

The Australian PAFC MRL is 50 ppm and the relevant vegetable MRLs are 2 mg/kg for beans and Brassica vegetables (including cabbage), 5 mg/kg for celery, 1 mg/kg for carrots and 5 mg/kg for leafy vegetables (including lettuce). Residues in vegetables and vegetable waste would be expected to be much less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb) was 0.003¹²⁶ giving an anticipated maximum residue from the feeding of vegetables and waste at 100% of the diet of $<50 \times 0.003 = <0.15$ mg/kg, less than the relevant international MRLs.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Tolclofos-methyl

-is a fungicide used for the control of seed borne *Rhizoctonia solani* in *potatoes*. Application is at 0.2 kg ai/tonne of seed potato.

¹²⁵ Public Release Summary on Evaluation of the new active THIAMETHOXAM in the product CRUISER 350 FS INSECTICIDE SEED TREATMENT National Registration Authority for Agricultural and Veterinary Chemicals January 2001 Canberra Australia

¹²⁶ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

There are no Australian, Codex or US MRLs for tolclofos-methyl in animal commodities. The Australian MRL for potatoes is 0.1 mg/kg.

The JMPR reported a lactating goat metabolism study where goats were dosed at the equivalent of 250 ppm in the feed for 4 days¹²⁷. No tolclofos-methyl was detected in liver or kidney. Radioactive residues in muscle and fat, at 0.2 mg equiv/kg and 1.1 mg equiv/kg, were too low for characterisation.

Residues in potato peel were *ca.* 6× that of the whole tuber. Maximum anticipated residues in potato peel from processed potatoes are 0.6 ppm.

It is anticipated that animal product residues will be below typical method LOQs.

Triadimefon

-is a fungicide used for the control of powdery mildew in *cucurbits* and *peas*. It is applied as a foliar spray at a maximum application rate of 50 g ai/ha for cucurbits and 62.5 g ai/ha for peas. The harvest WHP is 1 day for cucurbits and 14 days for the peas.

There are Australian and Codex but no US MRLs for animal tissues. The Australian/Codex residue definition is the sum of triadimefon and triadimenol. The MRLs are *0.05 mg/kg for edible offal and meat. The Australian and Codex MRLs for milk are *0.1 and *0.01 mg/kg respectively. The US residue definition is the sum of triadimefon and its metabolites containing chlorophenoxy and triazole moieties. The Australian MRL for cucurbits is 0.2 mg/kg, peas 0.1 mg/kg and 10 mg/kg for primary animal feed commodities.

In a lactating cow feeding studies were carried out with 1:1 mixture of triadimefon and triadimenol and at dose levels equivalent to feeding at 625, 1875 and 6250 ppm, fat contained residues up to 0.029 mg/kg at the 6250 ppm level and 0.016 mg/kg at the 1875 ppm dose level, whereas the residue level in the fat was less than 0.01 mg/kg at the 625 ppm feeding level¹²⁸.

It is anticipated that animal product residues will be below typical method LOQs.

Triadimenol

-is a fungicide used for the control of powdery mildew in *cucurbits* and ring spot in *cabbages*, *broccoli* and *cauliflower*. It is applied as a foliar spray at a maximum application rate of 100 g ai/ha. The harvest WHP is 1 day for cucurbits and 7 days for the Brassica vegetables.

There are Australian, Codex and US MRLs for animal tissues. The Australian/Codex residue definition is the sum of triadimefon and triadimenol. The MRLs are *0.05 mg/kg for edible offal and meat. The Codex MRL for edible offal and milk is *0.01 F and for meat is 0.02 mg/kg. The US residue definition is the sum triadimenol and its metabolites containing the chlorophenoxy moiety. The Australian MRL for brassica vegetables is 1 mg/kg, cucurbits 0.5 mg/kg and 0.5 mg/kg for forage of cereal grains.

See triadimefon above.

¹²⁷ 1994 JMPR - Pesticide Residues in Food - 1994 Evaluations, Part I Residues FAO Plant Production and Protection Paper 78. FAO and WHO 1995

¹²⁸ 1983 JMPR Pesticide Residues in Food - 1983 Evaluations, FAO Plant Production and Protection Paper 61. FAO and WHO 1985

It is anticipated that animal product residues will be below typical method LOQs.

Triallate

-is a thiocarbamate herbicide used for the control of wild oats in *peas*. The maximum application rate is 0.8 kg ai/ha with application occurring prior to sowing.

No harvest WHP is required.

There are Australian but no Codex or US MRLs for triallate in animal commodities. The Australian MRLs are *0.1 for edible offal (except kidney), 0.2 mg/kg for kidney, 0.2 mg/kg for fat and *0.1 mg/kg for meat and milk.

The MRL for legume vegetables and pulses is *0.05 mg/kg.

In a dairy cattle feeding study conducted at dose levels equivalent to 3 and 10 ppm in the diet, residues in tissues at slaughter were <0.01 mg/kg for muscle, kidney and liver for both dose groups and were 0.01 and 0.03 mg/kg in fat for the 3 and 10 ppm dose groups respectively¹²⁹. Residues in milk were <0.01 mg/kg.

The US EPA RED suggests residue in pea hay may require a tolerance of 1 ppm. Assuming feeding at 1 ppm in the diet, residues of triallate would be less than typical regulatory method LOQs.

It is anticipated that animal product residues will be below typical method LOQs.

Trichlorfon

- is an organophosphate insecticide used for the control of various insects in crops. It is registered on *vegetables* for the control of various pests including white caterpillar moth and on tomatoes for fruit fly control. The application rate is up to 75 g ai/hL or 0.875 kg ai/ha for vegetables and 125 g ai/hL for tomatoes.

The harvest WHP is 2 days.

There are no Codex MRLs for trichlorfon in animal tissues. The Australian MRL for cattle fat is 0.1 mg/kg while 0.5 mg/kg is the US tolerance. The Australian MRL for milks is *0.05 mg/kg while no milk MRL has been set in the US. The Australian MRLs for vegetables are 0.2 mg/kg for beetroot, Brussels sprouts, cauliflower, celery and sweet corn (corn-on-the-cob) and 0.1 mg/kg for other vegetables. Residues decline in soil and foliage with typical half-lives of 10 and 3 days respectively. Following peroral uptake of the trichlorfon (12.5 and 20 ppm in feed), no trichlorfon residues were detected (<0.1 ppm) in any of the examined tissues and organs (brain, heart, kidney, steak, fat) after a four week feeding period¹³⁰. Residues in vegetables and their waste are expected to be less than 20 ppm.

It is anticipated that animal product residues will be below typical method LOQs.

Tridemorph

-is a fungicide used for the control of powdery mildew in cucurbits. The application rate is 300 g ai/ha.

The harvest WHP is 2 days.

¹²⁹ Reregistration Eligibility Decision for Triallate List B Case 2695EPA 738-R-00-021 March 2001. Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division

¹³⁰ 1971 JMPR. Evaluations of some pesticide residues in food. AGP/1971/M/9/1; WHO Pesticide Residues Series No. 1, 1972

There are no Australian, Codex or US MRLs for animal commodities. The Australian MRL for cucurbits is 0.1 mg/kg.

No animal transfer or metabolism data was located for tridemorph. In a summarised study in dairy cattle¹³¹ where 4 animals were dosed with 500 mg/animal/day for 16 days, residues in milk were 0.01-0.04 mg/kg. No other samples were analysed.

Insufficient data were located to provide confident opinion on livestock residue risks.

Trifluralin

-is a selective dinitroaniline herbicide used for the control of certain grasses and annual broad-leaved weeds in vegetable crops. Application to soil before transplanting seedlings (*Broccoli, cabbage, cauliflower, tomato*) and direct seeding of crops (*Brussels sprouts, broccoli, cabbage, cauliflower, chicory, carrots, navy beans, green beans*) and is at a maximum rate of 1.1 kg ai/ha. No harvest WHP is required.

There are no Codex or US MRLs for trifluralin in animal tissues although there are registrations in the US including on vegetables (except carrot MRL 0.05) mg/kg and carrot (MRL 1 mg/kg). The Australian MRL for meat (mammalian) and milk are *0.05 mg/kg. The Australian MRLs for vegetables are 0.05 mg/kg except carrot (0.5 mg/kg), fennel bulb and parsnip (T0.5 mg/kg).

The US EPA evaluation of trifluralin states that based on a goat metabolism study where animals were fed at exaggerated rates there is no expectation of finite residues of trifluralin in animal tissues¹³². Residues decline in soil and foliage with typical half-lives of 60 and 3 days respectively.

It is anticipated that animal product residues will be below typical method LOQs.

Zineb

- is a dithiocarbamate fungicide used on a variety of crops. It is used on vegetables for the control of downy mildew, early and late blight, anthracnose and Septoria leaf spot etc at a maximum application rate of 140 g ai/hL for *beans, beets, carrots, cauliflower, cabbages, celery, cucurbits, onions* and *tomatoes*, 120 g ai/hL for *egg plant*, 100 g ai/ha for *peas* and *crucifers* and 1.36 kg ai/ha for potatoes.

The harvest WHP is 7 days vegetables except tomatoes (14 days) and potatoes (not required).

There are Australian and Codex but no US MRLs for zineb in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The Australian PAFC MRL is 50 ppm. MRLs for vegetables are beans 2 mg/kg, beetroot 1 mg/kg, Brassica vegetables 2 mg/kg, onions 4 mg/kg, carrot 1 mg/kg, celery 5 mg/kg, cucurbits 2 mg/kg, potatoes 1 mg/kg and tree tomatoes T5 mg/kg. Residues in vegetables and vegetable waste would be expected to be less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb) was 0.003¹³³ giving an anticipated maximum residue from the feeding of vegetables at 100% of the diet of $50 \times 0.003 = 0.15$ mg/kg, less than the relevant international MRLs.

¹³¹ Evaluation of fully approved or provisionally approved products. Issue 190: Evaluation on: Review of tridemorph, September 1999, Department of Environment Food and Rural Affairs, Pesticide Safety Directorate. UK

¹³² Reregistration Eligibility Decision, Trifluralin, List A Case 0179, Environmental Protection Agency, Office of Pesticide Programs, Special Review and Reregistration Division EPA 738-R-95-040, April 1996

¹³³ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994

Livestock residues are not anticipated to exceed international and/or domestic market standards.

Ziram

- is a dithiocarbamate fungicide used on a variety of crops. It is used on *celery* for the control of *Septaria* leaf spot at an application rate of 114 g ai/hL

The harvest WHP is 7 days

There are Australian and Codex but no US MRLs for ziram in animal commodities. The Australian MRL for edible offal is 2 mg/kg while the Codex MRL is 0.1 mg/kg, both as CS₂. The Australian PAFC MRL is 50 ppm and the celery MRL 5 mg/kg. Residues in celery waste would be expected to be less than 50 ppm. The target tissue is liver. The TF for liver (45 ppm feeding study for mancozeb) was 0.003¹³⁴ giving an anticipated maximum residue from the feeding of celery waste at 100% of the diet of $50 \times 0.003 = 0.15$ mg/kg, less than the relevant international MRLs.

The US residue definition is ziram (zinc dimethyldithiocarbamate), calculated as zinc ethylenebisdithiocarbamate.

Livestock residues are not anticipated to exceed international and/or domestic market standards.

¹³⁴ 1993 JMPR - Pesticide Residues in Food - 1993 Evaluations, Part I Residues FAO Plant Production and Protection Paper 124. FAO and WHO 1994